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Section on Surgery

American Medical Association

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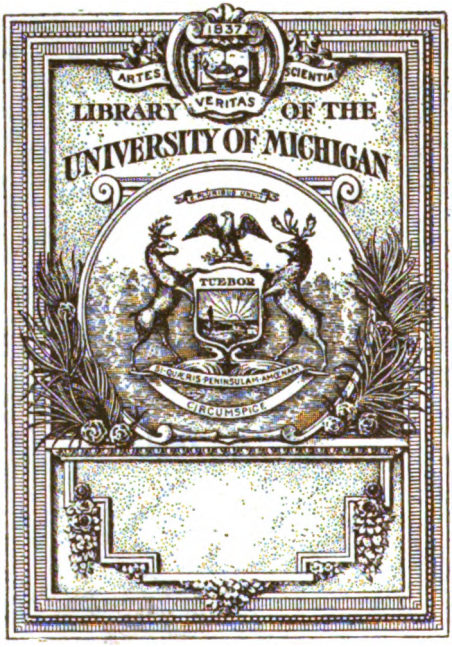

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TRANSACTIONS OF THE

SECTION ON SURGERY

of the
American Medical Association
at the Sixty-Fourth Annual
Session, held at Minneapolis,
Minn., June 17 to 20, 1913

AMERICAN MEDICAL ASSOCIATION PRESS
CHICAGO: NINETEEN HUNDRED AND THIRTEEN

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Delegate, J. N. Jackson, Kansas City, Mo.

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PROCEEDINGS OF THE SECTION

TUESDAY, JUNE 17—AFTERNOON

The Chairman, Dr. A. F. Jonas, Omaha, called the meeting to order at 2 p. m.

Dr. A. F. Jonas, Omaha, delivered the Chairman's address, entitled "The Surgeon and the Research Laboratory."

Dr. John B. Deaver, Philadelphia, read a paper on "Posterior Gastro-Enterostomy in Acute Perforated Ulcer of the Duodenum. Report of Thirty Cases." Discussed by Drs. A. J. Ochsner, Chicago; R. C. Coffey, Portland, Ore.; W. J. Mayo, Rochester, Minn.; W. W. Babcock, Philadelphia; K. A. J. McKenzie, Portland, Ore.; H. T. Sutton, Zanesville, Ohio, and John B. Deaver, Philadelphia.

Dr. Angus McLean, Detroit, read a paper entitled "Post-operative Ileus." Discussed by Drs. E. B. Claybrook, Cumberland, Md.; F. T. Murphy, St. Louis; D. N. Eisendrath, Chicago; W. W. Babcock, Philadelphia, and Angus McLean, Detroit.

Dr. John W. Perkins, Kansas City, Mo., read a paper entitled "Congenital Dislocation of the Knees, with Report of Two Cases." Discussed by Drs. L. Ely, Denver; R. H. Sayre, New York, and J. W. Perkins, Kansas City, Mo.

Dr. Hugh H. Trout, Roanoke, Va., read a paper entitled "Proctoclysis: An Experimental and Clinical Study." Discussed by Drs. L. L. McArthur, Chicago, and Hugh H. Trout, Roanoke, Va.

Dr. David Cheever, Boston, read a paper entitled "Etiology and Significance of Membranes about Cecum and Colon." Discussed by Drs. J. N. Jackson, Kansas City, Mo.; F. G. Connell, Oshkosh, Wis.; M. B. Trinker, Ithaca, N. Y.; J. W. Draper, New York, and G. M. Gray, Kansas City, Mo.

Dr. J. Louis Ransohoff, Cincinnati, read a paper entitled "Anaphylaxis in the Diagnosis of Cancer." Discussed by Dr. Oscar Berghausen, Cincinnati.

WEDNESDAY, JUNE 18—MORNING

Dr. Leonard Freeman, Denver, read a paper entitled "The External Bone Clamp Versus the Internal Bone Plate in Fractures of Long Bones." Discussed by Drs. J. B. Murphy, Chi-

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cago; L. L. McArthur, Chicago; A. E. Hertzler, Kansas City, Mo.; C. W. Allen, New Orleans, and L. Freeman, Denver.

Dr. John B. Murphy, Chicago, read a paper entitled "Surgical Management of Injuries to the Elbow-Joint, Primary and Secondary." Discussed by Drs. F. J. Cotton, Boston; Willy Meyer, New York; C. H. Lemon, Milwaukee, Wis.; H. M. Sherman, San Francisco, and J. B. Murphy, Chicago.

Dr. Charles H. Mayo, Rochester, Minn., read a paper entitled "Surgery of the Thyroid: Observations on Five Thousand Operations." Discussed by Drs. George W. Crile, Cleveland; A. J. Ochsner, Chicago, and C. H. Mayo, Rochester, Minn.

Dr. J. E. Thompson, Galveston, Tex., read a paper entitled "Study of the Circulation in Some Cases of Gangrene of the Foot." Discussed by Drs. C. W. Allen, New Orleans; W. W. Grant, Denver, and J. E. Thompson, Galveston, Tex.

Dr. Willy Meyer, New York, read a paper entitled "Extrathoracic and Intrathoracic Esophagoplasty." No discussion.

Wednesday, June 18—Afternoon

Dr. William D. Haggard, Nashville, Tenn., delivered the Oration on Surgery entitled "The Requirements of the Surgeon."

The following papers were read as a Symposium on Infections:

Dr. Frank Billings, Chicago: "Chronic Focal Infections as a Causative Factor in Chronic Arthritis."

Dr. Hugh H. Young, Baltimore: "Infections of the Prostate and Seminal Vesicles. Their Role in Toxemia."

These two papers were discussed by Drs. John Ridlon, Chicago; Bransford Lewis, St. Louis, and D. N. Eisendrath, Chicago.

Dr. Miles F. Porter, Fort Wayne, Ind., read a paper entitled "Injection of Boiling Water for Hyperthyroidism." No discussion.

Thursday, June 19—Morning

The following officers were elected: Chairman, Charles H. Frazier, Philadelphia; Vice-Chairman, J. E. Thompson, Galveston, Tex.; Secretary, E. S. Judd, Rochester, Minn.; Orator, Joseph C. Bloodgood, Baltimore; Delegate, J. N. Jackson, Kansas City, Mo.; Alternate, R. C. Coffey, Portland, Ore.

Dr. J. F. Percy, Galesburg, Ill., read a paper entitled "Nephritis as a Surgical Problem and Its Treatment as a Preliminary to Operation." No discussion.

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Dr. R. D. Carman, Rochester, Minn., read a paper entitled "Technic of Roentgenoscopy of the Gastro-Intestinal Tract, and Interpretation of Screen and Plate Findings." Discussed by Drs. A. MacLaren, St. Paul; J. T. Case, Battle Creek, Mich.; C. E. Ruth, Des Moines, Iowa; B. W. Sippy, Chicago; M. F. Porter, Fort Wayne, Ind., and R. D. Carman, Rochester, Minn.

Dr. Joseph C. Bloodgood, Baltimore, read a paper entitled "The Added Responsibility of the Surgeon when Called on to Treat Surgical Lesions in Their Earliest Stages." Discussed by Drs. A. B. Kanavel, Chicago; A. J. Ochsner, Chicago; F. D. Gray, Jersey City, N. J.; H. C. Sharp, West Baden, Ind., and J. C. Bloodgood, Baltimore.

Dr. J. Rilus Eastman, Indianapolis, read a paper entitled "Fetal Peritoneal Folds and Their Relation to Postnatal Acute and Chronic Occlusions of the Large and Small Intestine."

Dr. J. N. Jackson, Kansas City, Mo., read a paper entitled "Symptoms and Diagnosis of Membranous Pericolitis."

Dr. John E. Summers, Omaha, read a paper entitled "Surgical Aspects of Intestinal Stasis from an Anatomic Point of View."

These three papers were discussed by Drs. M. L. Harris, Chicago; H. H. Royster, Norfolk, Va.; A. A. Law, Minneapolis; D. N. Eisendrath, Chicago; J. N. Jackson, Kansas City, Mo.; J. R. Eastman, Indianapolis, and J. E. Summers, Omaha.

Dr. Emmett Rixford, San Francisco, read a paper entitled "The Mechanism of the Production of Fractures." No discussion.

Dr. Alfred Luger, Vienna, read a paper entitled "Radiographic Changes in Pituitary Disease." Discussed by Dr. Charles H. Frazier, Philadelphia.

Thursday, June 19—Afternoon

Dr. James T. Case, Battle Creek, Mich., read a paper entitled "Roentgenoscopy of the Liver and Biliary Passages." Discussed by Drs. L. G. Cole, New York; G. E. Pfahler, Philadelphia; A. D. Bevan, Chicago, and J. T. Case, Battle Creek, Mich.

Dr. Clarence A. McWilliams, New York, read a paper entitled "The Necessity of Preserving the Periosteum in Bone Transplantation."

Dr. Fred H. Albee, New York, read a paper entitled "Original Uses of the Bone Graft in Surgery."

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These two papers were discussed by Drs. J. E. Moore, Minneapolis; F. J. Cotton, Boston; D. B. Phemister, Chicago; H. O. Marcy, Boston; C. A. McWilliams, New York, and F. H. Albee, New York.

The following papers were read as a Symposium on Anesthesia:

Dr. Isabella C. Herb, Chicago: "Administration of Alkaloids before Anesthesia."

Dr. Harry G. Sloan, Cleveland: "Nitrous Oxid and Oxygen Anesthesia."

Dr. Charles H. Peck, New York: "Intratracheal Insufflation Anesthesia (Meltzer-Auer)."

Dr. J. F. Mitchell, Washington, D. C.: "Local Anesthesia."

Dr. W. M. Boothby, Boston: "Ether Percentages."

These five papers were discussed by Drs. C. W. Allen, New Orleans; Karl Connell, New York; Evarts Graham, Chicago, and H. G. Sloan, Cleveland.

Friday, June 20—Morning

Dr. William L. Rodman, Philadelphia, read a paper entitled "Gastric Tetany." Discussed by Drs. J. W. Draper, New York; M. F. Porter, Fort Wayne, Ind.; Robert Earle, St. Paul, and W. L. Rodman, Philadelphia.

Drs. Nathaniel Allison and Barney Brooks, St. Louis, read a paper entitled "An Experimental Study of the Mobilization of Ankylosed Joints." Discussed by Drs. D. D. Lewis, Chicago; J. H. Rishmiller, Minneapolis, and B. Brooks, St. Louis.

Dr. Bertram M. Bernheim, Baltimore, read a paper on "Therapeutic Possibilities of Transfusion."

Dr. J. J. Hogan, San Francisco, read a paper on "Theory and Practice of Transfusion."

These two papers were discussed by Drs. A. R. Kimpton, Boston; T. Sollmann, Cleveland; H. M. Sloan, Cleveland; V. C. Vaughan, Jr., Detroit; B. M. Bernheim, Baltimore, and J. J. Hogan, San Francisco.

The following resolution, introduced by Dr. J. F. Percy, Galesburg, Ill., was adopted:

Resolved, That this Section strongly endorses the action taken by the House of Delegates on the education of the public and the profession looking toward the control of cancer.

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THE SURGEON AND THE RESEARCH LABORATORY *

A. F. JONAS, M.D.
OMAHA

The advance of modern medicine and surgery is due to the casting off of the garments of preconceived hypotheses of bygone ages; a contempt for philosophic dogmas and a disregard for systems of practice not founded on the observations and elucidation of natural phenomena that are governed by definite and fixed laws. These laws have been revealed to us by scientific research, so that speculation by induction had to give way to a science based on objective observation. As our science broadened and became well founded, the art of surgery became highly developed, so much so that its operative possibilities appeared almost limitless. We must agree with David Starr Jordan when he says: "All art is based on science. Science is human experience tested and set in order. Art is knowledge in action. An art which is not based on knowledge becomes a mystery or trade. Sound medicine must rest on science."

While we have progressed in a marvelous degree during the last half-century, we cannot but feel that we still have much to do. We must confess that in many ways we have only begun. There remain so many questions on which we have no light, we therefore come together often to compare our views.

One of the purposes of this Section is to record our work, to exchange ideas and to study the collective experiences of this body. We interrupt our daily work in order that we may come together and review our

* Chairman's Address.

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labors, to thrash out problems, to retain the useful and to discard the impractical. We aim to strengthen the underlying surgical principles and to make our practical achievements more efficient.

When we consider the work of the various sections of this Association, we find that their work falls into two large and distinct groups. We find that to the first group belong the purely scientific and fundamental studies, namely, anatomy, physiology, chemistry, pathology and its coordinate divisions of histology and bacteriology. These are purely research and experimental and yet fundamental. To the second group belong the sections of the practice of medicine and surgery and its many subdivisions. I may say the divisions of applied science—the application of scientific principles to the practice and art of medicine and surgery. To the first division belong the men who devote themselves entirely to the unraveling of basic problems and the teaching of principles.

While modern medicine and surgery has its body of research men, whose labors have been entirely of a research and philosophic character, men whose labors have largely laid the foundations for the modern superstructure of the art of surgery, there is a large class of investigators who combine the art of their practice with laboratory research—men whose inspirations came to them during their daily labors in the operating-room and at the bedside, where practical observations are made that, sometimes, suggest certain theoretic solutions, the verification of which are found in experimental research; this developed the practical surgeon who solved his own problems in the laboratory. Then there are those surgeons whose daily labors are so burdensome and whose time is so completely taken up with practical work that the solution of many highly important questions is delegated to laboratory specialists. Besides there are those whose daily labors consume their energy and time to such an extent that no time is left for research work or

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even for thought. Their practical experiences, and often valuable obesrvations, are lost to the profession. These men neither publish nor publicly discuss their methods. There are still others who fail to share the results of their experience not only because of lack of time, but either on account of lack of training in recording, classifying and analyzing their material, or because their interest in medicine and surgery is pecuniary rather than scientific. Often their profession is to them a bread-and-butter affair and not one of a progressive science.

Briefly, we have the specialist in research work, who devotes all his time to the laboratory; the practical surgeon, who verifies his conceptions in the laboratory; the busy surgeon, who delegates the solution of his surgical concepts to the research specialist; the surgeon who has neither time nor inclination to record or discuss his work, and the surgeon who is often a simple technician, who is not troubled by anatomy, pathology, etiology or diagnosis, whose whole stock in trade is rapidity of movement, and who glories in the large number of cases that pass through his hands.

We have another class, an ever-increasing class, which is preponderant in our section, whose contributions comprise a record of applied surgical science; of a critical analysis of certain surgical principles applied to definite pathologic findings at the operating-table; of a clear understanding of infections which has so broadened the field for surgical endeavor that many operators now group their special cases, affecting certain organs, by the dozen, hundreds, and in some instances by the thousands, that they may be enabled to make their deductions with precision. Some of these operators are associated with pathologists of the highest order, men who study a living pathology both at the operating table and in an adjoining laboratory. The immediate investigation of living tissue has become a common practice, making operative methods more precise, and the limitations of surgical possibilities better understood.

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Surgery, then, has become more and more an exact science and its practice a highly specialized art. It became more an exact science because, like every other science, it was built up by the accumulation of unquestioned facts from contributions the world over. Philosophic deductions and preconceived theories and hypotheses into which facts were made to fit could not stand the test of a progressive science.

Still, we are not unmindful of the fact that the human machine involves many unsolved complex problems in the biology of a living organism. The mechanic has before him a less difficult task in the construction of a machine, and yet even he finds idiosyncrasies in many of his mechanisms that are built after the same model. He sometimes searches long before he locates and corrects a defect.

The surgeon, working under modern methods, can state in percentages the chances for restoration of function and the preservation of life in a large majority of surgical cases. But there remain many conditions in which the outcome is uncertain and in which the factors of safety are not fully understood. It is for the solution of these undetermined questions that the research laboratory is indispensable and the highly trained research specialist a necessity.

While the surgeon is thoroughly familiar with many factors that may operate for and against a favorable outcome, there still remain many unknown factors, in a large proportion of cases, that are difficult to estimate in given cases, and which affect the operative possibilities—factors that are not apparent at the time; consequently the operator often deals with unknown conditions, so that he cannot accurately estimate whether the task can be successfully accomplished or not. There remains to be worked out, therefore, many problems, biologic in character, that can be done only by highly trained laboratory workers, who must closely cooperate with the practical surgeon. The laboratory data, to be of

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practical value, must agree with the findings on the operating-table. The surgeon makes his observations on the living subject; the laboratory must elucidate and make them clear. The solution must be scientific. The methods of past ages have been speculative, which created, by induction, a philosophy that was often based on a very slender foundation of facts; facts that were often made to fit the philosophy. Our modern methods begin in the opposite direction, they consist of observation of natural phenomena. Preconceived ideas must give way to objective observations.

Much is required of the modern surgeon in the clear analysis of biologic detail. Therefore we must approach our problems in a scientific spirit. In order to do this we should be scientific investigators of the highest training. There should be a thorough knowledge of laboratory technic in all its details.

It becomes evident at once that this is not always possible. Surgeons who possess the highest and best skill, whose operative technic is beyond criticism, whose pathologic and diagnostic attainments are of the highest order, often men who have been pathfinders, can devote little or no time to laboratory research. Their time is completely absorbed with operative and hospital work and other professional duties. Their practical contributions have been of the highest value. Their theoretical deductions may have been right or wrong; only the research laboratory, in many instances, can determine the truth.

It may be said that all surgeons should command a thorough laboratory skill and the younger generation does. The leading medical schools insist that each student must have a thorough laboratory training that inculcates the scientific habit of thought and practice. He is encouraged to investigate unknown fields. To collect and correlate and analyze biologic, pathologic and technical data. He begins his professional career well trained, but, in many instances, the routine of daily

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duties absorbs his time, and the fatigue incident thereto unfits him for the laboratory. Perhaps his practical achievements absorb his enthusiasm. Possibly the laboratory never aroused a desire for that kind of work. Whatever the cause may be, we very soon find that the rank and file of the highly trained students cannot, or will not, devote any considerable time to research work. There remains, of the vast army of modern graduates, a small company of men who are imbued with the real scientific spirit—men whose love of the truth leads them where it may, outweighs all else. We are fortunate in that we have a growing class of such men. They often occupy positions in some of our large, well-equipped, highly organized and well-endowed hospitals.

They are often found in institutions that are controlled by or affiliated with medical schools, institutions in which there is a happy combination of hospital observation, of research work and teaching. Such an organization is capable of great good for progress. Then there is the isolated investigator whose ardor is not at all affected by his isolation. He works in solitude and alone and sometimes achieves epoch-making results. Take it all in all, the surgical profession may be divided into two groups: first, a small group, to whom we must look for progress and scientific advancement; and second, a group that composes the majority of surgeons who do the routine work of daily practice. Many of these are men of keen observation, who develop methods of practice based on clear ideas of living pathology found at the operating-table. It is true that many of our great discoveries and often epoch-making advances have been made by the practical surgeon; so thus the names of many men have become synonyms for certain procedures. Among Americans there are Ephraim McDowell and the beginning of abdominal surgery; Marion Sims and the repair of vesicovaginal fistula; Crawford Long and W. T. G. Morton and others and the discovery of anesthesia (1846); Fitz of Boston and the pathology of appendi-

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citis (1886); Valentine Mott and the ligation of large arteries for the cure of aneurysms; Philip Syng Physick and the use of buried animal ligature and the manipulation in the reduction of dislocations; Bigelow of Boston and the reduction of hip-joint dislocation and litholapaxy.

Among the pioneer surgeons of this country who originated procedures may be mentioned John Warren, who in 1804 first excised the parotid gland; Dr. Dixi Crosby of Hanover, New Hampshire, who did the first interscapulothoracic amputation for the removal of the upper extremity in 1836; Wolcott of Milwaukee, who performed the first nephrectomy and Bobbs of Indianapolis, who did the first cholecystotomy. Russell of Oshkosh is credited with the first suprapubic hysterectomy for uterine fibroid. Willard Parker, in 1867, reported a number of cases of suppurative typhlitis and saved 75 per cent. of the patients. Joseph K. Swift of Easton, Penn., and Gordon Buck of New York are credited with the first use of extension and counterextension for the treatment of fracture of the femur. John Warren of Boston was the first to do cardiocentesis. John Pancoast did the first successful operation for extrophy of the bladder. Detmold of New York, 1849, first evacuated a brain abscess. These names comprise a few of the practical American surgeons whose skill and rare insight have established new procedures.

Here we have a host of practical men who evolved methods of practice and whose only opportunity was found in the operating-room. They had no laboratories, were not trained in research work, but they understood the problems as they presented themselves and they mastered them. They were unmindful of tradition. They created means that succeeded. They were pathfinders. The paths were opened and it became the duty of those who followed to elaborate and elucidate the unnumbered obstacles that were encountered and to solve the problems which, as surgery advanced, became

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more complex and more difficult of solution. The unraveling of minute changes in the grosser lesions required more refined methods of investigation. The surgeon soon found that he must have a special training or that he must have the assistance of specially trained associates. He then turned for cooperation to the laboratory specialist, whose services he found invaluable, in fact indispensable.

The laboratory worker entered into close association with the surgeon. The investigator frequently stood beside the operating surgeon and observed the living pathologic structure as it was exposed. He obtained a history antedating the removal of the diseased tissues, and he followed the later progress of the case in order to fully appreciate a pathology from its beginning to its end. He began to investigate living structures. We had too long drawn our conclusions from the findings of post-mortem material, which represented only the end results. The study of living pathology is rapidly becoming the practice. Therefore, in order that we may appreciate to the fullest extent the early tissue-changes, the investigator must cooperate closely with the operating surgeon in order that he may solve the problems for which he is especially trained. While he is working with the surgeon, he need not be deterred from the investigation of problems of his own choosing.

The one danger of the investigator, working entirely by himself, is that he may become too theoretic; therefore the benefit of more or less close association with the operating surgeon. Experience has shown that cooperation in scientific work achieves the best practical results. The practical worker needs the assistance of the theoretic departments. Science is continuously progressive. No one branch of it can stand by itself; there must be cooperation, correlation of the one with the others. In the solution of the problem the investigator should have his own way and his own methods. The surgeon may present the problem and, in a general way, indicate the

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methods to be followed, but he must refrain from dictation, especially as to details. Frequent criticisms on his part would be confusing to the investigator and might be detrimental to the necessary enthusiasm. The investigation may be long, it may not lead to immediate results—in fact, it may apparently lead away from the subject; there may be an accumulation of theoretic data that may appear unimportant, but a persistence, keeping ever in mind the original problems, will lead to a solution. In the course of an investigation other problems may be unraveled.

To secure training and development the research specialist must serve an apprenticeship in the laboratory. The first aim of the laboratory should be to teach the student to observe, to see, to think, to comprehend. This is the chief aim of all objective teaching which begins with the fundamentals. When these have been mastered, the work must begin in well-equipped laboratories presided over by highly trained investigators and teachers.

The clinical and laboratory instruction must continue side by side and there should be a constant agreement between the two. Should any discrepancy arise, we should cling to the clinical findings rather than to those of the laboratory, for the sake of the sufferer, until the time arrives when there is absolute harmony between bed-side findings and the laboratory. Every student should be trained in all the essentials pertaining to clinical as well as laboratory technic. The laboratory worker who ignores bed-side findings does not fulfil his mission. Among the many duties of the instructors, an important one is to take note of such pupils as excel in laboratory work, men who possess powers of accurate observation, and give them special attention and encouragement, and to select and segregate those who are particularly qualified. The qualifications for research work are: first, keenness of observation, which means unlimited repetition until the results are established, and,

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second, an ability to correctly interpret facts and a recognition of their relationships. "Now, it is evident that you cannot make a sound conclusion without the facts, and these are gained by observation with and without experiment. It is equally evident that an isolated fact is barren and dead. Facts are like cells of a complex animal, all interrelated, mutually affecting and affected."[1]

The student cannot become well qualified except under expert instructors; men who are, first of all, professional anatomists, physiologists, biologists and who are expert in every branch of technic pertaining to these subjects. They must have had a large experience in research work before they become instructors. The student, by the acquirement of technical skill as well as training in learning to see, to weigh evidence and apply principles to his practice, not only becomes qualified for research work but it would seem that he is better prepared to do every-day practical surgical work, if he should choose to become a surgeon. I am of the opinion that the laboratory of the medical school should have in view not only the acquirement of routine knowledge of the various subjects, but the training should have the aim of training men both for the purpose of research work and for becoming proficient in operative technic; to better prepare them for the practical duties of their profession. The first consideration in the organization of the medical school has become the selection of men. Instructors are more important than equipment. No equipment can be adequate for a purpose until we have the man who plans and selects and knows how to utilize it to the best advantage. On the other hand, no matter how good the man is, he must have at hand all material for his purpose and he must have a place in which to work. To be of the greatest assistance to the surgeon, he must have a well-equipped laboratory and library and he must be so

1. Lyon, E. P.: Equipment and Instruction of the Laboratory Years, THE JOURNAL A. M. A., May 27, 1911, 1539.

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situated that he works in close intimacy with a surgeon in a well-equipped surgical hospital. He should be able to secure his pathologic material immediately after its removal from the body, so that he may investigate fresh tissues and not be dependent altogether on embalmed material. The surgeon must give every possible assistance and deliver his material in such a condition as to be most available to the pathologist for instruction and investigation.

The research laboratory should combine the features of all the other special laboratories. There should be an equipment for anatomic, physiologic, chemical, microscopic and biologic experiments. In a modern medical school in which these five special laboratories are situated in close proximity to the hospital, special research work may be conducted in one or all of them and the work may be carried from one to the other as may be necessary. As a matter of convenience, however, the work may be expedited best in a laboratory where the necessary special apparatus can be brought together.

In addition to the aforesaid special laboratories may be added a well-equipped surgical operating room where operations may be done on animals as taught in the Hunterian Laboratory of Experimental Medicine at Baltimore and the Institute for Experimental Medicine in St. Petersburg and many other institutions in this country and abroad. The principles of surgery should be taught, not special operations. The chief criticism against such surgical instruction has been that abdominal surgery has received the main attention, and that the pupils having had an operative course have been inclined to begin their practical activity with abdominal surgery.

To have all of this equipment is desirable and adds much to the convenience of the experimenter. But it must not be the first essential. The laboratory director is more important than buildings. A resourceful investigator outweighs fine apparatus. A skilled research-

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worker can, to a large degree, construct his own apparatus. In selecting a school, the student should ascertain whether or not it is well manned before he takes into account architecture and apparatus. As to being well manned, I mean manned with men who are patient, proficient, progressive; men who are not satisfied merely to investigate and verify what others have done, but who must advance, develop and create. Whether research worker or surgeon, or both combined in one, he must have time enough to teach and instruct the student. I have no patience with the laboratory investigator who says that he abhors the routine of teaching. No man is better qualified to teach than the one who has worked out the problem.

We must agree with Welch[2] when he says:

> A tendency at the present time to separate scientific research from the work of teaching has certain advantages, but has, I believe, even greater dangers. Scientific investigation in medicine, during the last two decades, has led to results of such vast importance as regards our power over disease that it makes an appeal to the public and to philanthropists much stronger than does medical education. Hence it is that large funds are available for institutions of research and for research hospitals which have no connection with education. Hospitals are often more eager to contribute to scientific medicine than to participate in the work of medical education and in a number of instances have been provided with funds and laboratories intended solely for scientific research. While there is room for such independent endowments and institutions, the roots of fruitful scientific work lie in the educational system, and if the latter is neglected the former will suffer. The traditional home and the most favorable environment for productive research is the university, and hospitals in affiliation with universities offer, I believe, the best opportunities for the promotion of medical science and art. Above all, the teacher should be an investigator.

If it is impossible to combine in one plant all the aforesaid special laboratories and one only can be had, then it must be admitted that the research laboratory should be in close proximity to the physiologic labora-

2. Welch, William. The Hospital in Relation to Medical Science, THE JOURNAL A. M. A., Nov. 19, 1912, p. 1667.

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tory with trained men. Physiology is the foundation on which clinical and research work must rest; it is the beginning. Clinical work, whether medical or surgical, can have no practical results unless founded on physiology. Therefore we must have a clinical physiology (Yandell Henderson).

The labors of Brown-Séquard, Claude Bernard, Ludwig, Fritch and Hitzig were fundamentally physiologic and necessary to the elucidation of clinical conditions. Bernard's discovery of glycogen, a physiologic study, led to an understanding of diabetes. His discovery of vasomotor nerves illuminated the problem of animal heat and fevers.

Clinicians have sometimes been slow to adopt and apply to practical use methods and means of common practice in the physiologic laboratory. An example is the measurement of blood-pressure in millimeters of mercury which had been done by physiologists fifty years before it found its way to the clinician (Yandell Henderson).

Only in very recent years has the surgeon availed himself of the value of the sphygmograph. The physiologist had already accumulated an immense fund of data.

Sauerbruch and Brauer made use of what was long since common knowledge of the physiologist—knowledge that enabled them to gain access to the interior of the thorax. The work of Crile on the subject of shock was an elaboration of the physiology of the vascular and nervous system. Cushing's splendid work on the pituitary body was a physiologic and anatomic study. In this same category belonged Erlanger's work on heart-block and Cannon's studies on normal movements of the stomach and intestines, and Meltzer on intratracheal insufflation. All of Carrell's work and that of Matas and Crile on blood-vessel surgery has been physiologic. When Senn, Murphy, Halstead and Connell taught us their methods of intestinal suturing, we found it to be based on physiology.

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Since all of our therapeutic endeavors are directed toward an attempt at a restoration of a disturbed or perverted function to a normal or physiologic condition, all of our experimental work must be fundamentally physiologic; and, finally, when we endeavor to use all of this work in a practical way, that is, to clinical ends, we have a clinical physiology. The more we know of physiology the more we know of clinical conditions.

The hospital laboratory should primarily cooperate with the staff in the unraveling of the nature of the diseases afflicting the inmates; in other words, in assisting and determining a diagnosis. Its other function, which may be far more important, consists in the study of undetermined problems. The laboratory staff should be so divided that one or more members should confine their time to the routine diagnostic work, which should have its own equipment and a separate laboratory. The research work should be entirely separated and have its own department. Its staff should have absolute freedom for its own work and in the working out of surgical problems. The surgeon should be consulted so that he may cooperate and aid in the studies. The surgeon is confronted, daily, by unsolved conditions; so he may suggest the kind of work to be done, and may indicate the object to be achieved. In this way the efforts of the research worker and surgeon will lead to definite ends. Crile, when he observed the disastrous effects of shock, both traumatic and emotional, drew his own conclusions as to the underlying cause. He called to his aid his laboratory colaborers and together they determined the cell-changes in the brain.

Aside from the numberless questions pertaining to the determination of limits of safety in surgical procedures that must be worked out, such as the questions in relation to immunity and to the immense field of serology, the margin of which has only been touched, vast unknown possibilities are in store for us. The science of pathologic tissues and bacteriology are suc-

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ceeded by a biochemical era. Much work has been done and an immense literature has accumulated and a vast army of earnest men have established innumerable facts in immunology and serology. Many principles have been established and yet many methods of practical application are still involved in much uncertainty; but the future will be full of revelations.

The unsolved question of the etiology of neoplasms offers an unlimited field for work. Is cancer due to a micro-organism or a perverted metabolism? Cancer seems to be increasing and why? While questions such as these are yet unanswered, an immense amount of information has accumulated. Much positive knowledge regarding its history, distribution and development; much that is more than suggestive as to its cause, and much negative evidence as to what does not cause cancer is at hand. Cancer research has been carried on with commendable activity since 1901 and 1902, when Loeb in America and Jansen in Denmark succeeded in transplanting cancer in rats and mice.

We have learned that cancer-cells may apparently grow indefinitely by transplantation through many generations. We have seen that cancer retrogresses under certain conditions; that there is such a condition as immunity to cancer; that cancer may, at times, gain in virulence. Experimental research seems to point to the cancer-cell as the real parasite rather than to a specific and distinct micro-organism. Family histories seem to point to heredity, but experimental research has taught us nothing. Mice have apparently been cured of cancer by serum therapy; what this may lead to in its application to man, is still uncertain. Coley seems to have established the principle of the cure of sarcoma by the use of serum of streptococcus and *Bacillus prodigiosus* in 10 per cent. of cases. Why the serum fails in 90 per cent. is a question for future determination. Ehrlich thinks that the beginning of the end of the cancer problem is in sight. I am sure that our optimism

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in relation to the eventual discovery of a cure by experimental research is well founded.

Much more might be detailed as to the great work on which the investigator has only begun. The possibilities are limitless. The work ahead is arduous and difficult. The rewards will be rich. The future of surgery and medicine will occupy a higher plane than any of which the optimist now dreams. For the present, the surgeon recognizes the necessity of the closest cooperation with the laboratory specialist. The one needs the other; both must work side by side.

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POSTERIOR GASTROJEJUNOSTOMY IN ACUTE PERFORATIVE ULCER OF THE STOMACH AND DUODENUM

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There are but few affections which can be compared with acute perforation of a duodenal or gastric ulcer in respect to the certainty of death without operation, contrasted with almost equal certainty of recovery if the appropriate operation is done in the early hours after perforation. Prompt diagnosis and rational treatment, therefore, are the chief issues, and the necessities of immediate action in the event of perforation demand a condition of preparedness on the part of the physician and surgeon if they are to seize the opportunity of performing the modern miracle of transmuting the very throes of death into life and health.

Perforation of duodenal or gastric ulcers is infrequent, but not so rare that any active physician will fail to encounter one or more instances in the course of his practice, while the active surgeon will see even more. In the last ten years I have had thirty-six cases. It has seemed to me that these have increased in number in the latter part of this period, a circumstance which I refer not to increased frequency of the disease but to more accurate recognition and application of treatment. The cases of fatal "acute indigestion" are diminishing somewhat by the withdrawal of this as one of the important conditions erroneously so-called.

DIAGNOSIS OF PERFORATED ULCER

The diagnosis in the early stages is usually so easy that when it is missed it is the result of inexperience or of being caught off guard. I have been impressed by

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the accuracy with which my house surgeons have recognized the condition, particularly when the question is fresh in mind by reason of a recent case.

The leading symptom is pain; the leading sign is rigidity; the leading clue is a history of previous indigestion of ulcer type. The pain and the rigidity are invariably present. The suggestive history is occasionally lacking.

The pain of perforation is sudden and violent. There may have been premonitory pains of great severity, but the pain of perforation is agonizing and unbearable. It may come on during exertion or follow the ingestion of food or fluid. It will be described in various terms, but of its intensity there is no question. Its very severity often precludes exact localization by the patient. It is abdominal, not pelvic, midabdominal often, epigastric or hypochondriac often, and in the iliac fossa occasionally, radiating to the back at times, but in general in the early portion of the seizure it is upper abdominal. Sometimes the patient detects a sensation at the moment of rupture as if something had burst in his abdomen. The posture is characteristic. These patients lie on their backs, the thighs flexed, every muscle tense, the facies anxious, and they are disinclined to shift their position.

General rigidity of the abdominal muscles sets in at once after perforation. The rigidity is of the extreme type often called board-like. It is most marked in the upper abdomen. So tense are the muscles that the abdomen is at first retracted, and, at times, a transverse depression is seen at the level of the umbilicus. There is no other condition in which the upper abdominal rigidity is so early and so marked as in perforated ulcer.

Extreme tenderness also is present at once after perforation. At first it is located over the site of perforation, but with the rapid spread of peritonitis, other areas of peritoneum become sensitive to pressure, and a source of difficulty in diagnosis is hereby introduced

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In perforated duodenal or pyloric ulcers particularly, the peritoneal irritation spreads rapidly along the paracolic grooves into the right iliac fossa, and when the patient is first seen a few hours after perforation this area may be quite as tender as the epigastrium, thus accounting for a frequent error of diagnosing perforated ulcer as perforative appendicitis.

Were it the physician's privilege to be present at the time of perforation and observe the sequence of development of symptoms and signs, the spread of the peritonitis from above downward could be followed and the diagnosis made correspondingly easier, since appendicular peritonitis can as easily be traced from the iliac fossa to the upper peritoneum. Such an opportunity is rare and we must therefore bear in mind this characteristic rapid spread of peritoneal involvement, when we first see the patient after an interval has elapsed. Pelvic and rectal tenderness supervenes rapidly and may be of assistance in determining the existence of general peritoneal inflammation.

A history of prior abdominal trouble was present in all the cases which have come under my observation, the duration of symptoms ranging from two weeks to fifteen years. The sufferings of the patient dull his memory for details and render the time inopportune for the development of an exact history. Still, at times, from the patient himself, from his physician or from his friends, a satisfactory ulcer history can be obtained. Occasionally, as happened in several instances, no clear history pointing to preexisting ulcer could be obtained, even by questioning after recovery. This history then, when present, is of great assistance, but its absence by no means excludes the diagnosis of perforation.

This is the practical picture of perforated ulcer. If it is remembered and all the rest forgotten I am convinced that more diagnoses will be made than are made at present. The diagnosis is a feat of clinical observation and deduction based on the great outstanding and

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individual features of the disease. The attempt to place any other symptom or sign on the same plane of importance with those just mentioned will in individual cases result in disaster. A brief discussion of the subsidiary symptoms and signs will suffice.

Shock at the onset has been observed. In a greater or less degree it is not infrequently associated with the severe pain of perforation. But people are differently constituted in respect to the reaction to pain. Shock may be slight or very transient, and in most patients after a very few hours not even the slightest element of shock can be seen.

Vomiting is almost constant and is a symptom of value. It is not invariably present, however, and is a symptom of such common occurrence in varied general and abdominal disorders that it serves but little purpose in diagnosticating the condition of perforation. Nausea and vomiting may be noted as of almost uniform association of auxiliary, but not distinctive, value. Blood in the vomitus is seldom seen, but when present is decidedly helpful.

The temperature, pulse and respiration rates are very misleading if the attempt is made to attach diagnostic importance to them. Let me cite, without selection, a few of the observations made on the operative cases in this series:

Temperature	Pulse	Respiration
98.3	104	24
99.4	92	24
99.	108	34
97.4	112	32
98.2	78	36
99.	96	28

These observations are fairly illustrative of the temperature, pulse and respiration at times ranging from six to fifteen hours after perforation. It will be seen that the temperature is least affected, not infrequently being normal, but naturally showing a slight tendency toward elevation.

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The pulse is, as a rule, moderately accelerated. Again, it may be normal. There is nothing distinctive in its quality, which is frequently full and good.

The respirations are increased slightly as a rule. This is due, more than to any other factor, to the rigidity of the abdominal muscles and the diaphragm, which forces the breathing to assume the true costal type necessitating more frequent respirations for the purpose of aeration. In short, in the remedial stage of perforation there is nothing in the temperature, pulse and respiration to suggest the urgency of the patient's condition. Later, when the patient is getting ready for the pathologist instead of the surgeon, the temperature, pulse and respiration show great changes, a description of which is interesting for the student of the biology of disease but lacking in help to the sufferer.

Distention, the accumulation of fluid in the abdomen and the subsidence of peristalsis, "the silent belly," are also terminal events, of prognostic, but not of diagnostic, importance.

Free gas in the abdominal cavity and the obliteration of liver dulness are also signs which should be stricken out of the text-books or labeled indelibly as false friends. Too much stress has been laid on these signs as indicative of perforation of the bowel. Liver dulness may be diminished or abolished either by gas in the peritoneal cavity or by gas in the intestine, but in either case it requires a large amount of gas to produce this effect. If the gas is in the intestine it requires marked distention, which, in the case of perforated ulcer, can come about only when peritonitis is advanced and as a rule irremediable. If it be free gas in the peritoneal cavity which causes obliteration of liver dulness, it must be present in considerable amount.

It is obvious that in the early stages of perforation the amount of gas which escapes from the opening must be dependent on the size of the opening and the amount of gas present in the stomach and adjacent

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bowel. I have operated in a case in which the opening in the ulcer was 3 cm. in diameter, but as a rule these perforations are small, in many cases being described as pin-point, and at the time of operation only fine bubbles of gas can be seen escaping very slowly. It would require a long time for the free gas thus escaped to produce much effect on liver dulness. Yet a high grade of peritonitis may already be present from the infection which has been liberated. I have operated in cases in which there was no free gas whatever in the abdominal cavity. When there is practically no gas in the stomach or duodenum there is naturally no escape into the peritoneal sac. Gas is not formed by the activity of gas-forming organisms in the peritoneal cavity until late in the disease. As an aid in helpful diagnosis, therefore, the obliteration of liver dulness is more of a hindrance than a help.

The leukocyte count is of some help, chiefly in differentiating such non-inflammatory conditions as gastric crises and abdominal angina. A leukocytosis appears very quickly in the vast majority of cases. In nineteen cases in which a complete blood-count was made the average leukocyte count was 16,082 per cubic millimeter and the polymorphonuclear neutrophils averaged 85.3 per cent. In one case of perforated gastric ulcer, however, the leukocyte count was 7,300 and the polymorphonuclear percentage 70. The perforation had existed eight and one-half hours and a well-marked diffuse peritonitis was present. A second case of perforated duodenal ulcer gave 8,850 leukocytes and a polynuclear percentage of 89. The highest count observed was 23,600, and the highest polymorphonuclear percentage was 95 in two patients, both of whom recovered. In this condition, therefore, as in appendicitis and other intra-abdominal inflammations, I deprecate the attempts which are occasionally made to set up the leukocyte or polynuclear count as arbiters of diagnosis or prognosis.

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Finally, in the cases in which uncertainty exists as to the precise diagnosis the evidences of an acute abdominal catastrophe requiring surgery are so plain that from the point of view of treatment no mistake should occur.

METHOD OF TREATMENT

In discussing the method of treatment one thing should be clearly understood at the outset, namely, that success depends on promptness of action more than on any other single factor. If closure of the perforation is effected during the first twelve or eighteen hours a considerable percentage of recoveries may be expected even though the surgeon be inexpert. After about twenty-four hours the vast majority of patients are beyond human skill.

The influence of the time factor is seen especially well in this series. No operation was performed in ten cases, six of duodenal and four of gastric ulcer. In the six duodenal cases all the perforations had occurred over two days and the patients were practically moribund on admission. In only one of these cases was the attempt made to operate. In this case after a few whiffs of ether the patient became pulseless and the attempt was abandoned. Three other patients were in a dying condition, and the remaining two died without operation one and one-half hours after admission.

Of the four patients with gastric perforations, one, with a perforation of three days' standing, arrived at the hospital in a dying condition; one was practically moribund and died in five hours; one was pulseless, the symptoms of perforation dating back one week, and died in ten hours. Only one is given in the records as having sustained perforation within twenty-four hours. This patient was a man aged 40 who had felt the symptoms of perforation only six hours previously. Nevertheless his condition was such that he died untouched one hour after admission. This is the only patient that had had the perforation within twenty-four hours or less before operation who failed to recover, and this case

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shows that an occasional patient will succumb with fulminating rapidity. The ulcer in this case was 1 cm. in diameter and was situated on the anterior surface of the stomach.

These cases represent the only selection against operation, and had I felt that there was a chance of recovery or even of enduring the operation they would have been given the benefit of the doubt. At the present time in reviewing the records I am convinced that there was no chance of saving these patients, for as has well been said "the resources of surgery are rarely successful when practiced on the dying."

In the twenty-six patients operated on there were eight gastric and eighteen duodenal ulcers. Twenty-five recovered and one died. The death occurred in a patient who had a perforated duodenal ulcer of twenty-nine hours' standing. This was the only case in which more than twenty-four hours had elapsed before operation. The operation was simple suture of the ulcer, completed as rapidly as possible on account of the patient's condition. Death, however, occurred from toxemia in ten hours. Three of the patients had perforations which had existed for twenty-four hours before operation. The remainder were all operated on at various times within that interval. The patient that died also had the only case of duodenal ulcer in which simple suture of the ulcer was done. In all the rest a posterior gastrojejunostomy was made at the primary operation. In only two cases of gastric ulcer was a simple suture of the ulcer performed. The remaining six had a gastrojejunostomy in addition.

The line of treatment adopted in this series was (1) closure of the ulcer; (2) plication of the duodenum to obliterate its lumen and fortification of this area by covering with the gastrohepatic and the gastrocolic omentum; (3) posterior no-loop gastrojejunostomy; (4) tube drainage of the pelvis through a suprapubic stab. The after-treatment consisted in the sitting pos-

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ture, continuous proctoclysis, prohibition of everything by mouth until peristalsis was reestablished as evidenced by auscultation and especially by the passage of flatus. The stomach-tube was employed freely for vomiting, regurgitation or gastric distention. Experimentation with food was begun after the passage of flatus, beginning with albumin water. No purgatives were given, but a cleansing enema was given on the third day after operation.

These results warrant a strong plea for the performance of gastrojejunostomy as a primary procedure in addition to the closure of the perforation. The only exception I would make is in the case of patients who are desperately toxic or shocked, and the only condition I would impose is sufficient degree of familiarity and dexterity with the operation of gastro-enterostomy.

I have already spoken of the good general condition of the majority of these patients in the early hours after perforation. Gastro-enterostomy is one of the least taxing of major abdominal operations in respect to shock. Are not the objections to its performance rather theoretical than real, and should not the benefits of the operation, both immediate and remote, outweigh the fancied dangers? The slight prolongation of the operation need only rarely be considered as a contra-indication. If one has any belief in the curative powers of gastro-enterostomy the future of the patient must be brighter than if suture only has been done. Patients will seldom submit to a secondary gastro-enterostomy after recovery from perforation. The supposed danger of the infection of the lesser peritoneal cavity by gastro-enterostomy has been much overrated. I have not seen an instance of this condition. The early peritonitis of perforated ulcer seems to be in many cases more a chemical than a bacterial peritonitis due to the irritating secretion from the duodenum and stomach. Of twenty cases in this series in which a culture was made from the peritoneal fluid, fourteen showed no growth. The

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colon bacillus was found four times, streptococcus once and a mixed culture of *Staphylococcus aureus* and *albus* and the *Bacillus alcaligenes* in the remaining case. This is quite a different state of affairs from the peritonitis due to perforation of the lower portion of the bowel. Of course, infection rapidly occurs, organisms accumulate and the end-result is not different from infection of the peritoneum from other sources, but it is evident that the bacterial element in perforated gastric and duodenal ulcer is less serious in the early stages than might be supposed. Moreover, if the general peritoneal cavity is able to dispose of the accumulated infection present at the time of operation, the lesser cavity may be trusted to dispose of the slight soiling at the time of gastro-enterostomy.

The primary gastro-enterostomy places the perforated area at rest, favoring immediate quiescence and ultimate healing. Coexisting ulcers, if present, are favorably influenced. The chance of perforation of a second ulcer is diminished. The risk of hemorrhage from the bed of the perforated ulcer or from a second ulcer is minimized. In the case of duodenal perforation any narrowing in the lumen due to suture is compensated for by the anastomosis. This permits thorough and sufficient enfolding of the ulcer without fear of gastric retention. In my cases I have purposely caused pyloric stenosis by plication in order not only to safeguard the closure of the perforation but also to establish and render permanent the function of the new opening. The risk of leakage is greatly lessened by this procedure. The administration of fluid and food by mouth can be begun earlier and with confidence.

All these factors make for a reduced primary mortality. Paterson, in 112 consecutive cases of perforated gastric ulcers, found that 11 per cent. of the patients died shortly after operation from a second perforation, from hematemesis or from leakage along the line of suture. In my series there were no deaths from these

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causes, a fact which may justly, in part at least, be attributed to the favorable influences of the gastro-jejunostomy.

The only complication which gastro-enterostomy has added, so far as I can judge, is in one case of intra-abdominal hematoma probably from a vessel in the transverse mesocolon. It was necessary to operate and drain for this condition. One patient vomited for several days after operation, but recovered without any secondary procedure. The wound was infected in five cases. Postoperative obstruction occurred in two cases, requiring operation. Both patients recovered. In one case the obstruction was certainly, and in the other it was probably, due to adhesions along the tract of the pelvic drainage-tube. In the future in early cases with but little inodorous fluid I propose to omit pelvic drainage. Irrigation I never employ. The peritoneum not only does not need it, but is better able to cope with the infection if not flooded with watery fluid. Neither do I mop out the fluid through fear of doing injury to the endothelium. Through the suprapubic stab I aspirate the pelvic fluid during and after the operation.

With the remote results of this method of operation I am equally pleased. This phase of the subject I shall be obliged to reserve for a subsequent communication. I am at present advocating primary gastrojejunostomy for its beneficial influence on the immediate mortality of perforation. It is fortunate that this operation chances also to be the curative operation for many varieties of chronic ulcer, and we are not surprised, therefore, that its beneficial influence is felt in the subsequent history of these patients.

Finally, I wish to reiterate my conviction that, while gastro-enterostomy does not compare in importance with closure of the perforation in gastric or duodenal ulcers, it is nevertheless a factor of first magnitude in the immediate cure and ultimate result.

1634 Walnut Street.

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ABSTRACT OF DISCUSSION

DR. A. J. OCHSNER, Chicago: I wish to emphasize the very great importance of recognizing the necessity of immediate surgical intervention whenever the group of symptoms that has been given exists. Now, if this group of symptoms should be present in a case of perforation of the gall-bladder, or of a thrombosis of one of the mesenteric vessels, or of acute pancreatitis, the indication for treatment would be precisely the same. Then if a surgeon of only mediocre ability should be present, the question might arise as to whether it would be best to wait for the purpose of obtaining a surgeon of great skill. The patient with any one of these conditions is very much more likely to recover in the hands of any surgeon who is clean and who knows enough not to do too much, within twelve or eighteen hours, than he would be in the hands of the best surgeon twelve hours later. So that here you have a condition in which the mediocre surgeon must simply provide a closure of the leakage and drainage for the surgeon who is to perform the gastro-enterostomy.

I believe that Dr. Deaver's advice to do a gastro-enterostomy is good. I believe it would be wrong for one who has not performed this operation to do it. The risk is too great, but any one can cover an ulcerated surface by folding it lengthwise; or he can cover it with a piece of omentum and then put in drainage. Dr. Deaver also advised stomach lavage and proctoclysis. That is good advice. We need not fear any harm from stomach lavage, provided nothing is put into the stomach after washing it out. If you follow out that treatment you will give the patient a mighty good chance to recover.

Dr. Deaver also tells you that the posterior gastro-enterostomy puts the parts at rest. Gastric lavage does the same thing. No matter what is wrong inside the gastro-intestinal tract, the two things to do are gastric lavage and proctoclysis.

I wish to emphasize particularly this one point, of taking these symptoms to mean that you must provide this form of relief. Suppose you have made the wrong diagnosis. If the patient comes to you a little late and you make a diagnosis of appendicitis or extra-uterine pregnancy, you make an opening over the appendix and you find it only slightly inflamed; if you find a few bubbles of gas there, you will say that there is a hole higher up. Of course, if there is a perforated appendix, you will know where the gas comes from, but that is a symptom or sign which must invariably lead you to make an opening higher up and do whatever your ability permits you to do.

DR. R. C. COFFEY, Portland, Ore.: If all duodenal ulcer operations could be performed by Dr. Deaver, I would not say

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a word in discussion, because I think he has outlined the perfect treatment, provided you have at hand an expert surgeon like Dr. Deaver and a hundred others I could mention. Unfortunately that is not always the case, particularly in the West. Probably two-thirds of the operations for acute abdominal conditions are done, not by the surgical specialist, but by the general practitioner who first sees the patient, the man who does his own appendectomies, and who goes into the abdomen with the full expectation of finding appendicitis in more than half of the cases. Instead of that he finds the condition that Dr. Deaver described. This is illustrated by the fact that within a week my assistant called my attention to the fact that I had done more cancer operations in the last year than I had done appendectomies. The reason for that is that the acute work in the West, like appendicitis operations, is done largely by the general practitioner. If the men who are capable of removing the appendix in an emergency were to treat the condition Dr. Deaver described, the mortality would be tremendous. On the other hand if they took the more moderate course, they would save a great number of their patients. If Dr. Deaver's paper were to be read only by surgeons, it would be ideal, but over half of the patients in this country are not operated on by skilful men but by men who do their own surgery, and who, instead of doing a gastro-enterostomy in thiry minutes, do it in three hours. It is dangerous. Those men who are not prepared to do gastro-intestinal surgery, but who are doing good emergency work, like appendicitis operations, ought to stay away from the more dangerous ground.

The treatment Dr. Deaver describes is the correct one. I bring the omentum over the ulcer. There is no danger of producing a fistula, providing you have the whole area covered with omentum. That will give you a good result, and men with meager skill or surgical ability will have almost as good a result as the expert surgeon who attempts to do the radical operation. Furthermore, gastro-enterostomy does not cure in a large percentage of these cases. The suturing over of the ulcer which has perforated is necessary. Infolding the intestine is only a temporary affair, and if you will take a roentgenogram a few weeks after the operation you will find that the duodenum is back where it was before the operation.

DR. W. J. MAYO, Rochester Minn.: There are several things that Dr. Deaver brought up that are of very great importance, and one is that he puts all of his emphasis on the duodenal ulcer. Years ago it was gastric ulcer that was emphasized, but to-day it is duodenal ulcer because the surgeon has shown as good results from operations on patients with duodenal ulcer in at least 75 per cent. of all cases.

Dr. Deaver spoke of the acute abdomen. That is also a very important subject. The things that produce the acute

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abdomen are, first, the appendix; second, the duodenum; third, the condition of acute pancreatic perforation; fourth, perforation of the stomach, and of the gall-bladder; and in the pelvis we get conditions that simulate a thrombosis of the mesenteric vessels. If we keep these five things clearly in mind, we will get the vast majority of cases that will go to the general surgeon.

Dr. Deaver put emphasis on the question of early operation, just as Murphy, Deaver, Ochsner and others have done in regard to appendicitis. But it is even more important that we should have an early operation in duodenal ulcer, because in the average case we cannot expect to do the operation in twenty-four, thirty-six or forty-eight hours and still expect the patient to recover; the operation to be life-saving must be done within the first twelve hours. As Dr. Deaver said, the condition of the patient is extremely good in the first twelve hours, therefore, we can do a gastro-enterostomy if we have the patient where we can give him the best possible care, but that can be done only in good hospitals, with skilled assistants, with conditions favorable and with men familiar with the operation. It is better, however, to be operated on by the man with little experience, in twelve hours, than by the best surgeon in the world after twenty-four hours. He must do the one thing that will cure the patient at that time, and he must be mindful of the fact that the patient needs to have a second operation, and that it is only the living patient who can have a second operation.

The secretions in these ulcers are extremely acid. A chemical peritonitis occurs, and in a few hours the bacteria gain power, the infection spreads all over the already irritated peritoneum, and the patient dies. In gastric ulcer I would like to have Dr. Deaver say what course he would pursue in the first twelve hours. We have tried several plans. One of the best is to draw up the stomach, put a drain into the opening in the stomach, and drain into the bottom of the peritoneal cavity.

Dr. Wayne Babcock, Philadelphia: I feel, as have the last two speakers, that the chief problem is whether or not gastro-enterostomy should be done in these cases. I have had an experience with eighteen cases of acute perforated ulcer in the duodenum in which the condition was recognized, and the frequency of the condition as compared to acute gangrene of the appendix is about one to twenty-five. Many of the patients were admitted with the proper diagnosis, and many entered with a diagnosis of appendicitis. As Dr. Deaver said, residents after seeing one case usually recognize the second case.

The results of our treatment have been somewhat interesting because in no case have we done a gastro-enterostomy. In the early cases I believe I operated on these patients with

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a diagnosis of appendicitis, for symptoms are often in the appendix region, and when the abdomen is opened the appendix is found blistered, but the striking thing is that the fluid around the appendix is mucilaginous, not thin as one finds with appendicitis. Once we recognized this point we immediately opened above and found the ulcer. It is interesting that only seven of these eighteen patients gave a previous history of ulcer; two gave a history of somewhat recent abdominal traumatism. Of these eighteen, sixteen were men and two were women; young adults, of middle age. Eleven came to the hospital and were operated on after twelve hours had elapsed; seven reached the hospital and were operated on after twenty-four hours had elapsed. There was one that reached the hospital after seventy-two hours and one on the fifth day. The interesting feature in the last-mentioned case was that the patient recovered although there was a general peritonitis with a greatly distended abdomen. The patient who came to the hospital on the third day also recovered.

At the end of twelve hours one man died as the result of secondary abscess of the liver. Of the two that entered the hospital after twenty-four hours, one man entered on the twenty-seventh and the other on the thirtieth hour; both died, having been moribund on admission. The other fifteen recovered. In one case with a recent ulcer diagnosis, at first the attempt was made to suture the ulcer, but the suture does not hold well in sodden tissue, so after our first experience we put a pad of gauze against the ulcer and drained the abdomen and put the patient to bed.

The final results are of special interest. Of these fifteen patients only one continued to show ulcer symptoms; the other fourteen remained free from symptoms. The fifteenth returned after ten months and had a secondary gastro-enterostomy. In the case of the others, is a gastro-enterostomy had been done the good results obtained would have been ascribed to that operation and not to the procedure employed.

Dr. K. A. J. MacKenzie, Portland, Ore.: I have had very limited opportunity of observing the condition under discussion. The cases I have had, however, have served as some food for reflection and study. I can recall five acute cases of perforation in which there was extravasation of the contents of the stomach or duodenum, or both. These cases have been invariably accompanied by shock, so that in most instances operation looked like a serious matter. It was done, however, and satisfactorily in all instances but one. This patient died after seven days. Another patient had additional perforations and recovered after secondary operation. Two others managed to make their escape.

When the question of gastro-enterostomy is being considered as a measure of affording permanent relief in these cases, it makes me think seriously as to whether or not it is sound

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surgery; whether the technic which consists simply of incision of the abdomen and closure of the opening in the bowel, with adequate drainage and enteroclysis, is not perhaps the best. After all, we should avoid serious operations such as Dr. Deaver mentioned, because, even in the hands of skilful operators, they must consume at least twenty or thirty minutes. I am appalled to think that any group of patients should be able to stand it, so I would protest against such a procedure. Any surgeon who is a great anatomist like Dr. Deaver takes a serious responsibility in proposing such an operation before a gathering of this kind. I should say that even in the hands of the average operating surgeon the mortality would be very much higher than it would be if a more simple procedure were followed, such as that proposed by Dr. Babcock. I do not think that the great surgeons should recommend these more serious operations. It reminds me of what Mr. Lane proposed some years ago, the removal of the colon; we have no opportunity afterward of unscrambling the egg. When a proposal such as this is made, when this paper, for instance, goes out into the world, a great many operations will be performed, whether by skilled surgeons or otherwise matters not, and many patients will die. The mortality will be large, so large that the figures will be appalling, and those who propose this operation must feel some degree of responsibility.

DR. H. T. SUTTON, Zanesville, Ohio: It might be of interest for me to recite an experience that I had a few years ago with a strong, otherwise healthy man of 29, who complained of indigestion of several years' standing and gave a history of having had the symptoms that Dr. Deaver would pronounce those of perforation of the stomach. I examined him and concluded that he was suffering from a gastric ulcer. I advised operation. On opening the abdomen, I found the omentum plastered to the stomach, and not having the experience nor the skill of Dr. Deaver I proceeded to uncover the stomach to see what had happened. I found that there had been an ulcer and that a perforation had occurred, which Nature had buried very kindly, much better than even a Deaver or a Mayo could have patched it up. The result was that that man was very miserable the rest of his life, and advised all his friends never to submit to an operation, because he had been very comfortable before and was very miserable afterward. So that if we are going to operate on all these patients who simulate ulcer of the stomach or duodenum, God pity humanity. So far as I am concerned personally, if I had an ulceration of the stomach with perforation, I tell you that, notwithstanding the greatness of the men who have spoken, I would rather be treated by the poorest physician than be operated on by the best surgeon.

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DR. JOHN B. DEAVER, Philadelphia: I am very much obliged to those who agreed with me so heartily. As for the last speaker, he belongs in the medical section, not in the surgical, but if he stays here long enough he may soak up some wisdom. As to the question of the family doctor operating, we are not living in that age, I hope. This is not an operation for the family doctor to do; it is not an operation for the man who does obstetrics and attends scarlet fever and measles. It is an operation for the surgeon and only the expert surgeon should undertake it. There are certain conditions that are extenuating circumstances. Judgment must be exercised. The operation must be adapted to the case and not the case to the operation. Nevertheless, the principles underlying my contentions are correct—this operation accomplishes the greatest amount of good in the greatest number of cases. We need pay no attention to the crossroads surgeon. The man who has not the experience and ability has no business to do intestinal surgery. Only those surgeons who have spent a lifetime doing this work ought to be allowed to do it. There are few places in this country in which a surgeon cannot be found who can do this work within twelve hours. Patients do not die in twelve hours. I have never seen one die yet. At the end of twelve hours you can do so much surgery that you will be surprised that they do not die. They never die if you are operating in a sterile field. The Germans called attention to the bacteriology in this class of cases, and the good surgeon of to-day is the man who understands bacteriology. In my thirty cases there were only four from which I could grow a culture. The others were sterile, and the patients were operated on within twelve hours. That is the time when we are operating in a sterile peritoneal cavity.

Dr. Mayo emphasized certain points that are true. Certain cases of gastric ulcer really do not permit of a posterior gastro-enterostomy. I have had one patient with three consecutive perforations, the last one being in the posterior wall of the stomach. He recovered. This is a very important subject. I am sure that you understand my position in the matter, particularly as to who should and who should not perform these operations.

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ETIOLOGY AND SIGNIFICANCE OF PERICOLIC MEMBRANES

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The cecum and its near relatives and coadjutors, the ascending and transverse colons, have recently received a generous share of attention from surgeons, internists and roentgenologists, displacing in this respect the appendix, whose lesions, symptoms and treatment have by common consent been received into the accepted dogma of the profession. Among the interesting questions before us is that concerning the etiology and significance of certain membranous structures which are frequently found enveloping these organs in whole, or in part, and are designated by such terms as pericolic membranes, membranous pericolitis, parietocolic membranes and Jackson's membrane.

Whatever degree of importance may be assigned to these structures in the future by our riper judgment, it must always be a source of pride that the American profession has contributed so largely to their elucidation. Many times must they have been observed in the post-mortem and dissecting-room before Virchow in 1853 described them and speculated on their significance. Lane in his earlier papers subsequent to 1903 speaks of them in general terms, undoubtedly confusing types of varying cause and importance, and they have been mentioned specifically in a number of anatomic studies; but it remained for Jackson in 1909 to formulate them as a definite clinical entity, with a definite symptom-complex and plan of treatment.

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Jackson's paper with its contained account of the pathology by Hall, deservedly ranks as a classic for students of these conditions. In Germany, Hofmeister, Wilms, Fischler, Klose, Stierlin; in America, Binnie, Martin, Mayo, Crossen, Gerster, Connell, Pilcher, Frazier and Flint; and in England, Gray and Anderson have contributed important papers. Within two months, long after the preparation of the present paper was begun, articles by Eastman and Connell have appeared, which largely anticipate the conclusions presented herein. Nevertheless, so much confusion of terms and difference of opinion still exist, that it seems still justifiable to bring forward further evidence.

No one can review the literature on this subject without feeling certain that much of the confusion is due to the fact that conditions of widely different origins are erroneously supposed to be identical. In my opinion these membranes may be divided etiologically into two groups: (1) congenital, and (2) those due to peritoneal irritation. Under the second heading may be included, unless indeed they deserve to constitute a class by themselves, the omental pseudomembranes due to the adhesion of the border of the omentum to the parietes, most often on the right, and thus covering the ascending colon and cecum. This adhesion is doubtless due to the same irritation responsible for the other cases included under Class 2. No one, I presume, doubts the passage through the intestinal wall of irritating substances, whether bacteria or their products or more purely chemical irritants, without gross perforation. The region of the appendix is of course the most common example, but more striking instances of the response of the peritoneum to this type of irritation is seen in the extensive membranes covering the site of certain non-perforating gastric and duodenal ulcers and spreading far over adjoining viscera, or those associated with a malignant adenoma of the colon or with diverticula of the sigmoid. The process is apparently partly

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a proliferation and partly a floating up of delicate layers of the peritoneum with the formation of large lymph-spaces and new blood-vessels. I confess to some skepticism as to the passage of irritating bodies through the intestinal wall in the absence of ulceration, or of some other condition more evidently harmful than stagnation. The weight of experimental evidence seems to be in favor of it, yet it is well to remember that the alimentary tube is designed to contain, to retain for a considerable time, and to excrete substances undergoing chemical or bacterial decomposition, without permitting their passage through its wall. If fecal stagnation and transudation of irritants cause these membranes, why do we not see them on the descending colon and sigmoid; or, if it be asserted that they exist in these situations, why do we not find them on the under surface of the transverse colon? A third hypothesis as to etiology is the mechanical theory, chiefly championed by Lane and Fagge, which as I understand it imputes to these membranes a teleologic significance, regarding them as developed to fix viscera which are insufficiently supported. Here again, it is probable that different structures are under consideration. Probably all will admit that normal peritoneal fixations and these membranes also, if present, will become thickened and fibrous in response to the abnormal drag of a dilated, atonic and prolapsed cecum.

To return to the first group—the membranes of congenital origin—this is composed, according to my belief, of membranes of the type so ably described by Jackson and Hall. The evidence of their congenital origin is almost indisputable. The thin, diaphanous veil, springing from the posterolateral abdominal wall, on the right, overlying in varying degrees the ascending colon, but so loosely attached to it that it may be divided and lifted up with scarcely any bleeding, leaving an apparently normal colonic peritoneal surface, and the absence of any thickening or hyperplasia or change in consistency of the colonic wall, constitute a picture quite

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different from our conception of an inflammatory process. Moreover, this type of membrane seems to occur solely in this region. Gerster, Lane, Anderson and Gray speak in rather general terms of membranes involving the cecum, ascending colon, hepatic and splenic flexures, descending colon and sigmoid, but the reader is left in some doubt as to what type of membrane is meant. The great majority of writers, notably Jackson, Connell, Frazier, Flint, Pilcher and Eastman, state or imply that the type of membrane under consideration is confined to the right colon. This is highly suggestive of a developmental origin, for however perverted a function we ascribe to the cecum and right colon, as a cause of pericolitis, it is hardly conceivable that in all cases the rest of the colon may not share in the condition and form similar membranes.

The apparently overwhelming proof of the developmental origin is, however, to be found in the study of the fetus and new-born infant. Jackson, in a recent paper, says that he knows of no observations of pericolic membranes in infancy or childhood; meaning, probably, in the living subject. My own experience has given me a contrary impression; I have seen a well-marked pericolic veil in a child aged 12, and examination of new-born infants has duplicated the experience of Flint, Connell and Eastman, expressed in their recent convincing papers. Flint found in two out of three embryos the undescended cecum attached by veil-like membranes, and well says that unless we accept the unproved theory of fetal peritonitis, these membranes must be considered but variations of the normal. He might well have added "unless we are willing to believe in cecal and colonic stasis in the fetus as the cause of peritoneal irritation, these membranes must be regarded as developmental." Eastman establishes the apparent identity of the "parietocolic fold" of Jonnesco and Juvara, and the "bloodless fold" of Treves with Jackson's membrane, and states that among twenty-eight

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fetuses of over 6 months, these membranes were found in five and nine cases, respectively.

In an examination of thirty still-born infants, ranging from approximately 6 months to full term, in the anatomic laboratory of the Harvard Medical School, we found in four instances characteristic veil-like membranes extending from the parietes over the hepatic flexure and ascending colon (and in one instance over the cecum) and fusing with the peritoneum of the colon near its mesenteric border (see Figs. 1 and 2). In three of these instances there were other developmental aberrations present, such as lack of normal fixation of the cecum, a continuance of the gastrohepatic omentum to the right between the duodenum and gall-bladder, a Meckel's diverticulum and an undescended testicle. This coexistence of other variations may be considered significant in the etiology of the veils. Dissection of seventeen younger embryos proved inconclusive, because, having been preserved in alcohol or formaldehyd solution, the peritoneal reflections were so friable and altered in appearance as to cast doubt on the accuracy of the observations; but at least a well-founded suspicion was entertained that three of these presented pericolic membranes. It will be noted that these percentages correspond roughly with those of Flint and Eastman.

Granted that membranes of the type under discussion are confined to the cecum and proximal colon, and are developmental, it would seem that the exact method of origin must be involved in the rotation and descent of the cecum from its first point of fixation beneath the liver. This process has been reviewed so often of late that it is well understood. The suggestion of Mayo that the cecum insinuates itself beneath a fold of parietal peritoneum and pushes it downward before it, while plausible enough on account of the laxity of the latter, is yet rendered improbable, as Jackson says, by the fact that the cecum itself is frequently not covered.

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The adhesion of the omental edge to the parietes over the cecum, before its descent, might closely simulate this condition. On the whole, the most satisfactory hypothesis attributes the process to the twisting of the cecum and proximal colon on its long axis after primary fixation and during descent. When the cecum, by the rotation of the colon on the root of the mesentery as a fixed point, passes to the right beneath the liver, the ileum enters it from the right, and the twisting which brings it ultimately to enter from the left probably occurs normally in the most natural way, so as to draw the recently attached parietal peritoneum behind the ascending colon, which process would obviously be obscured by further adhesion. It is reasonable to suppose that under certain conditions the twist may occur in the opposite direction, which would have the effect of drawing the attached peritoneum over the colon in such a way as strongly to suggest a Jackson's membrane. It is not strange that proof of this is hard to obtain, as was the case in Connell's investigations. In one instance I found the ileum entering from the front in such a way that a twisting outward, backward and inward to its adult position would be very improbable, while the more probable twisting inward and backward would have drawn the parietal peritoneum over the ascending colon like a Jackson's membrane.

The importance of the exact etiology of these structures is chiefly to aid us in estimating their clinical significance. It may be agreed at once that any membrane, whatever its origin, which operates to fix or confine the appendix in such a way as to interfere with the proper drainage of its lumen into the cecum is a menace to the life of the individual. Similarly, membranes which confine the colon, and thus impair its peristalsis, must be assumed to be noxious. But do these slender, tenuous veils of congenital origin suggest such confinement? It may be doubted whether such slight fixation is often of much importance. Although

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the analogy is not complete, the condition may be compared with that of the duodenum, which, broadly and firmly fixed behind, overlapped by the border of the pancreas, crossed at its second portion by the transverse mesocolon and at its third portion by the root of the mesentery, yet discharges its function without embarrassment save in rare instances. The cecum has acquired a bad name—it is variously termed a sink, a sewer, or a cesspool. Perhaps it is possible to be carried too far in our conception of the proximal colon as a pool harboring dangerous toxins and a bacterial flora which, at the slightest retardation of its flow, will be absorbed into the circulation or pass through the bowel-walls and cause a local inflammation. It may be profitable to return to the teachings of physiology and recall that the cecum and proximal colon are homologous with a portion of the alimentary tract in the herbivora in which stasis is essential to proper digestion; that in man, who is in part herbivorous, the intestinal contents, after a rapid passage through the jejuno-ileum, are poured into the cecum still containing half of the fluids and a material portion of the absorbable solids which have been ingested, and that Nature, through anatomic arrangement and antiperistalsis, seems to emphasize the desirability of a retarded flow through this portion of the bowel.

The diversity of therapeutic measures proposed is striking; thus Wilms corrects a mobile cecum by placing it in an extraperitoneal pocket, while Fagge denies the value of this procedure. Hofmeister and many others mobilize the ascending colon (and presumably the cecum) by dividing parietocolic adhesions, while Klose fears the mobile colon and sutures it to the wall. It is noteworthy that among the many reported cases of plastic operations on pericolic membranes the great majority were subjected also to a removal of a suspected appendix or to operations on the pelvic organs, or to various other procedures, so that it is difficult to esti-

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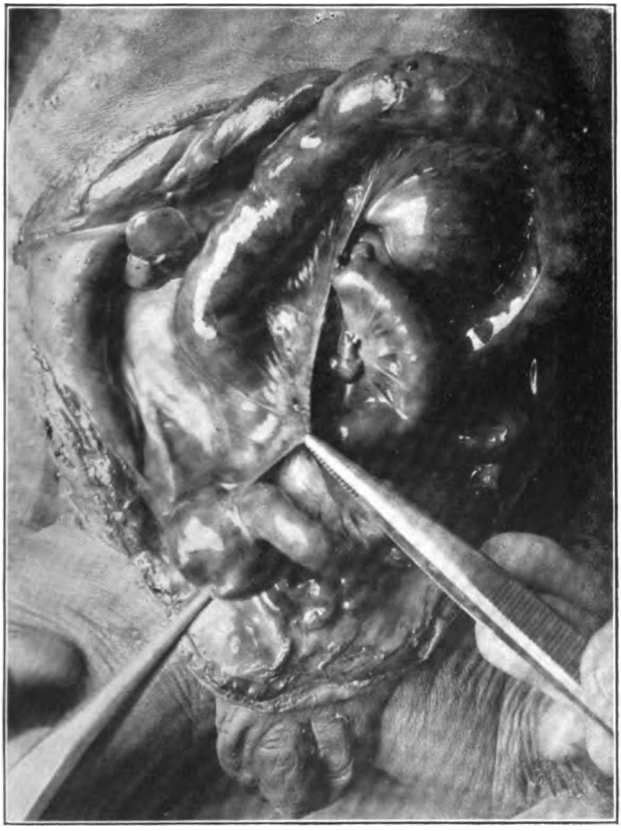

Fig. 1.—Abdomen of a new-born infant showing a Jackson's membrane covering the ascending colon. The rudimentary omentum may be seen at the free border of the transverse colon, unrelated to the membrane.

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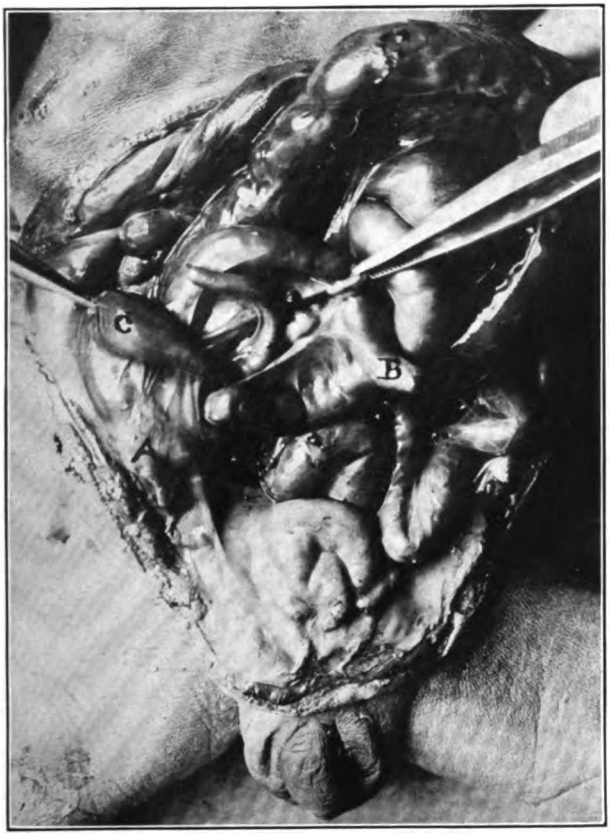

Fig. 2.—The same subject with the cecum of fetal type and appendix raised to show a genitomesenteric fold connecting the mesentery of the terminal ileum with an undescended testicle. The small intestine has been removed except the terminal ileum, whence may be seen springing a Meckel's diverticulum. *A*, undescended testicle; *B*, Meckel's diverticulum; *C*, cecum.

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mate the effect of freeing the membranes alone. Moreover, few of these cases have been reported in detail as to results. There remain, however, a number of cases presented by such careful observers as Jackson, Pilcher, Flint and others in which the familiar symptom-complex of pain, distention, tenderness, constipation, mucous discharges and later sequelae were relieved by simple division of pericolic veils.

On the clinical side my own experience is as yet inconclusive. It consists of seventeen cases of right-sided pericolic membranes observed since attention was directed especially to these conditions. Of these, six were associated with and presumably were caused by a recurrent subacute appendicitis, and presented no distinct clinical picture of their own; two were similarly associated with duodenal ulcers, and one with an inflamed Meckel's diverticulum. The remaining eleven were of the type of Jackson's membrane previously described; in none of these were any lesions of the viscera noted, except the unrelated ones for which the operation was undertaken, nor were there swollen glands or other evidences of inflammation as described by Hofmeister. In eight of these eleven cases there were no symptoms attributable to the membranes, which were discovered merely in the course of a routine exploration; in the remaining three cases there was right-sided discomfort, indigestion, flatulence and moderate constipation. In one of these, a woman, the abdomen was closed without disturbing the membrane, and general measures, as urged by Martin and Coffey and others, were instituted with marked improvement. In the second case in the same sex, the membranes were divided with relief, up to the present, of all symptoms except the constipation, and in the third case, a man of neurasthenic habit, the operation gave no relief.

The evidence from the laboratory and the operating-room here presented, and a study of the work of others, has given me the very strong impression that the veil-

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like pericolic membranes of the type described by Jackson are congenital variations, occurring in at least 10 per cent. of individuals and causing in the majority of instances no symptoms whatever. In the infrequent cases in which there is satisfactory evidence that they constrict and obstruct the function of the colon, they should be divided, preferably with the cautery protected by a spatula introduced beneath the membrane, as advised by Hofmeister. Jackson's recent reported experience in two cases gives us ground to expect that after division they may not form again. The other type of membrane, whose cause is either inflammation spreading from some visceral lesion, or, as I think less likely, peritoneal irritation from intestinal stasis, are more likely to cause symptoms and require operative relief. Further progress in these problems will follow the careful analysis of the symptoms and living pathology of many cases by many observers, and above all the conscientious interpretation of after-results.

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BIBLIOGRAPHY

Lane, W. A.: Lancet, London, 1903, i.
Lane, W. A.: Lancet, London, 1904, ii.
Binnie: Month. Cycl. Pract. Med., 1905, xviii.
Corner and Sargent: Ann. Surg., 1905, lxi.
Wilms: Deutsch. med. Wchnschr., 1908, No. 41.
Sweetser and McLaurin: Tr. West. Surg. Assn., 1908.
Wilms: Deutsch. Ztschr. f. Chir., 1908, xxxvii.
Bittorz: Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1909, xx.
Jackson, J. N.: Surg. Gynec. and Obst., September, 1909.
Klose: München. med. Wchnschr., 1910, No. 7.
Hausmann: Deutsch. Med. Wchnschr., 1910, No. 47.
Clark, John G.: The Surgical Consideration of Congenital and Developmental Defects Leading to Obstinate Constipation, THE JOURNAL A. M. A., Aug. 6, 1910, p. 449.
Lardennois: Am. Jour. Med. Sc., September, 1910.
Martin, F. H.: Surg. Gynec. and Obst., January, 1911.
Mayo, C. H.: Surg., Gynec. and Obst., March, 1911.
Smith: Anat. Rec., 1911.
Wilms: Proc. Fortieth Cong. Ger. Phys., 1911, p. 276.
Mayo: Tr. West. Surg. Assn., 1911.
Allard: Med. Klin., April, 1911.
Crossen, H. S.: Surg., Gynec. and Obst., July, 1911.
Gerster, A. G.: Ann. Surg., September, 1911.
Satterlee and Lewald: Some Apparently Obscure Conditions of the Gastro-Intestinal Tract and the Practical Application of the Roentgen Ray in their Diagnosis, THE JOURNAL A. M. A., Oct. 14, 1911, p. 1255.
Connell, F. G.: Surg., Gynec. and Obst., November, 1911.

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Pilcher, L. S.. Ann. Surg., January, 1912.
Connell, F. G.: Surg., Gynec. and Obst., October, 1912.
Gray and Anderson: Adhesions Affecting Lower End of Ileum and Colon, Univ. Aberdeen, 1912.
Frazier, Ch. H.: Ann. Surg., October, 1912.
Flint, J. M.: Johns Hopkins Hosp. Bull., October, 1912.
Rovsing: Ann. Surg., 1913.
Mayo, W. J.: Am. Jour. Med. Sc., February, 1913.
Jackson, J. N.: Ann. Surg., March, 1913.
Eastman, J. R.: Surg., Gynec. and Obst., April, 1913.
Connell, F. G.: Surg., Gynec. and Obst., April, 1913.
Gray and Anderson: Lancet, London, May 10, 1913.
Fagge, C. H.: Lancet, London, May 10, 1913.
Gray and Anderson: Lancet, London, May 17, 1913.
Fallon, F. M.: Proc. Mass. Med. Sc., June, 1913.
Hofmeister, F.: Beitr. z. klin. Chir., lxxi.
Francke: Mitt. a. d. Grenzgeb. d. Med. u. Chir., xxii.
Jonnesco and Juvara: Progrès méd., xix, 273.
Treves: Anatomy of Intestinal Canal and Peritoneum in Man, Hunterian Lectures, London, 1885.
Reid, Douglas: Jour. Anat. and Physiol., xlv, 73.
Virchow: Virchow's Arch. f. path. Anat., 1853, v, 281.
Klem: Mitt. a. d. Grenzgeb. d. Med. u. Chir., xvi.
Klose: Deutsch. Ztschr. f. Chir., lxii.

ABSTRACT OF DISCUSSION

DR. JABEZ N. JACKSON, Kansas City, Mo.: The origin of the pericolic membrane is of as much mystery to me now as it was when I first saw it. The view is generally held, however, that this vascular membrane is found frequently about the right side of the colon, and that it is associated with a definite symptomatology. I am satisfied that there are a great many persons who have a membrane caused by the vascularity common to this condition, and who do not manifest any symptoms. The membrane in itself is not productive of symptoms at all until something takes place in that membrane. It is a sort of mechanical obstruction either to the appendix, or to the bowel itself, anchoring it in the lumbar fossa. I am also inclined to say, that the congenital theory as to the origin of the membrane will generally explain the conditions present, although I have seen one or two instances in which I was perfectly satisfied that the case was of inflammatory origin. In the majority of instances this condition is characteristic in the fact that the cecum is rarely involved. The membrane begins just above the cecum and extends upward to the hepatic flexure, to about the beginning of the attachment of the omentum. Keiler first told me that this membrane was pulling down a layer of descending colon, so that I am inclined to believe that it is a congenital membrane, although Eastman's theory, that the condition is inflammatory, is also tenable. I do not believe that it is inflammatory in the sense that it comes from a peritonitis. I should say that this membrane formed as the result of an irritation caused by the obstruction of the toxins in the ascending colon. In inspecting the abdomen after death from poisoning by bichlorid

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of mercury, no change is found in the stomach or small intestines, but in the ascending colon up to the hepatic flexure the tissues are perfectly blue, showing that that particular part of the intestine has a tendency to absorb at least one toxic substance, namely, mercury. This part of the intestine may be the one that absorbs the toxins of low-grade bacteria, and that might account for the toxic origin of the pericolic membrane. I feel sure that there are cases in which the membrane develops sufficiently and assumes a characteristic clinical course, so as to set up a definite train of symptoms. When we operate in these cases we always find the membrane about the colon.

Dr. F. Gregory Connell, Oshkosh, Wis.: I am glad to see that the question of the etiology of this condition is being brought forward and emphasized, because the more important aspect of this condition is its cause. If this membrane formation is secondary to an inflammation, either in the appendix or in the mucosa of the colon, then an operation outside of the bowel which does not remove the primary cause in the lumen of the bowel surely would not lead one to expect an entirely satisfactory result. I want to agree emphatically with Dr. Cheever in his conclusions regarding the congenital development as a cause of this condition. The fact seems to be not strongly emphasized; the fact is lost sight of that there may be coincident inflammation and defective development which would account for this condition in a typical case in which Jackson has so beautifully described the pericolic membrane. He says that the cecum is not ordinarily involved, but that when it is there may be a secondary or resulting inflammation, and that this inflammation secondary to defective development would account for a large number of these cases. There is no doubt that these kinks and membranes are present and cause symptoms. Some four years ago I removed gallstones from the gall-bladder, and also removed an acute appendix. There was a typical pericolic membrane, as described by Jackson. It was entirely pericolic; that is, it did not involve the cecum or appendix. This was some years ago, when we did not know as much about this membrane as we do now, and, on account of draining the gall-bladder, I was afraid of a retroperitoneal infection, and therefore did not touch the membrane. The patient, however, did not improve after the operation. Some six months later I operated again, and found that this pericolic membrane had become more firm and leathery. The blood-vessels in it had entirely disappeared, and there were streaks of connective tissue. There were no postoperative adhesions from the removal of the appendix. There was a marked dilatation of the cecum below this constricting band. The pericolic membrane was divided, the cecum was fixed to the posterior parietal wall, and there

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had been a marked improvement in the case. Another case was rather unusual in that a volvulus or torsion of the cecum secondary to a pericolic membrane was present.

DR. MARTIN B. TINKER, Ithaca, N. Y.: It seems to me that the point brought out by Dr. Cheever near the close of his paper, that these membranes rather rarely cause serious trouble, deserves emphasis. I have an impression that these membranes clash with simple ovarian cysts, which in times past have received so much attention and rarely caused any trouble. In clinics in which much abdominal surgery is done we rarely see interference with these bands. I have seen a great deal of surgery in the Mayo clinic. I have seen Dr. Ochsner and Dr. Crile, and others all over the country, operate, and I do not recollect having seen any of these men ever interfere with one of these bands. It seems to me that while there may occasionally be cases in which the bands might give rise to trouble, they really in the majority of instances offer no excuse for needless surgery, and in the hands of some men more is done with these bands than circumstances require.

DR. J. W. DRAPER, New York City: I was struck by what Dr. Jackson said in regard to the localized condition of the inflammation in the colon in cases of poisoning by mercury, because we have observed practically the same thing, namely, the localization of the toxemia of intestinal obstruction in dogs. Dr. Wallace has shown exactly the same thing in toxemia following large injections in animals of diphtheria toxins. It is quite easily conceivable that this may have a very important bearing on the subject.

DR. G. M. GRAY, Kansas City, Kan.: I merely wish to make a suggestion in connection with these bands which we meet so often. In every case in which there is a marked ptosis of the cecum and ascending colon these bands are present, and, to my mind, and as suggested by Dr. Coffey, they are really Nature's effort to protect a falling bowel. The fact of their always being met on the right side of the abdomen would also indicate that they are due to irritation of the falling cecum. So long as the colon remains on the normal shelf in the abdomen, we do not meet with pericolic membrane. When it leaves that shelf and ascends into the pelvis, this membrane is always present. I have seen many cases of ptosis of the cecum and ascending colon, and I do not recollect a single case in which these bands were not present. I attribute to the descent of the colon the irritation from the stasis that is produced in the bowel by this ptosis and the production of these bands, at least, in a large number of cases. They have no particular significance except that they are often protective and the individual might suffer more if they were severed.

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ANAPHYLAXIS IN THE DIAGNOSIS OF CANCER *

J. LOUIS RANSOHOFF, M.D.
CINCINNATI

Two years ago I published a preliminary report[1] on the experimental study of anaphylaxis in cancer. I showed that there is a decided difference in the anaphylactic reaction when guinea-pigs sensitized with blood-serum from a normal individual and other guinea-pigs sensitized with blood-serum from a cancer-bearing individual are both given a final dose of blood-serum from a cancer-bearing individual. Two series of guinea-pigs were used in each experiment. Pigs of Series A were sensitized with normal blood-serum in doses varying from 0.01 to 0.5 c.c. Series B was sensitized with the same amounts of blood-serum from an individual bearing an advanced cancer. After two weeks, when sensitization was established, each pig, of both Series A and Series B, was given an intraperitoneal injection of 5 c.c. of blood-serum from a cancer-bearing individual. The results were decisive. The pigs of Series A, those pigs sensitized with normal blood-serum, had symptoms of anaphylaxis which appeared promptly and were of the usual severity. The pigs of Series B, those pigs sensitized with blood-serum from a cancer-bearing individual, had mild, if any, symptoms. In Series A the symptoms appeared promptly; while in Series B they were, when present, delayed. Evidently the pigs of Series B, those sensitized with cancer blood-serum, had

*From Cincinnati Hospital Laboratory.

1. Ransohoff, J. L.: Experimental Study of Anaphylaxis in Carcinoma, THE JOURNAL A. M. A., July 8, 1911, p. 103.

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been immunized against the anaphylactic reaction, as they did not react when a final dose of cancer blood-serum was injected.

From these experiments I inferred that there is some specific substance in the blood-serum of cancer-bearing individuals probably absorbed from the cancer itself. Since then I have applied this method of showing the difference in the anaphylactic reaction of normal and cancer blood-serum to the diagnosis of cancer. As a sensitizing dose of 0.1 c.c. gave the best results in the preliminary experiments, I am now using it in all the work.

Pigs weighing from 200 to 400 gm. are most susceptible and are used in all tests. The pigs of each group are divided into two series, A and B. Each pig of Series A is sensitized with 0.1 c.c. of blood-serum from a normal individual; each pig of Series B, with a like amount of blood-serum from an individual bearing an advanced cancer of any type, the diagnosis confirmed by microscopic examination. After ten days the pigs are ready for the diagnostic test. From 3 to 5 c.c. of blood-serum from the suspected case are injected intraperitoneally into Pigs A and B, the dose being graded according to the weight of the pigs. When the blood-serum is from a normal individual, both Pigs A and B have the ordinary prompt severe symptoms of anaphylaxis. In case the blood-serum is from a cancer-bearing individual, Pig A shows the ordinary severe symptoms, Pig B shows mild symptoms, if any. Even when mild symptoms are present, they are delayed.

For example: Pig A shows distinct symptoms in from one to two minutes, while the symptoms of Pig B may be delayed from five to ten minutes or even longer. So marked is the difference in the symptoms of the two pigs that an untrained observer may interpret the reaction. In fact, all the tests have been interpreted by workers in the laboratory. Sensitized guinea-pigs are kept in readiness for tests when the occasion arises.

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The pigs remain sensitized for an indefinite period. In some cases correct tests have been made ten weeks after sensitization.

At the risk of repetition I must again state that the tests have been interpreted by fellow workers in the laboratory, students and laboratory attaches. In all I have fifty cases to report. Thirty of these were cancer (Table 1) and twenty were non-malignant (Table 2). The tests were never positive unless cancer was present. The anaphylactic diagnosis of cancer was not made unless proved by subsequent operation, post-mortem, microscopic examination or, in a very few cases, by the course of the disease; namely, the death of the patient with all the clinical symptoms of cancer. In four cases of cancer the test was negative. Strange to say and difficult to explain, these were, with one exception, advanced cases: (1) advanced case of cancer of the stomach; (2) advanced case of cancer of the gall-bladder; (3) advanced case of cancer of floor of the mouth; (4) very early cancer of the stomach without tumor formation.

In all the cases examined the margin of error was 8 per cent. Therefore, the correct diagnosis was made in 92 per cent. Taking the cancer cases alone, the error is somewhat larger, 13.3 per cent. incorrect, or 86.7 per cent. correct, diagnosis. The tests made in all classes of cases according to the material available were as follows: uterus, 4; breast, 10; tongue and floor of mouth, 5; stomach and intestines, 6; thyroid, 1; lymph-nodes, 1; gall-bladder, 2; prostate, 1.

Dividing the cases into incipient, operable, and inoperable, there were six incipient, twelve operable and twelve inoperable. By incipient I mean cases with small tumor formation and without involvement of the lymph-nodes.

In three cases a very interesting experiment was made. The tests were made in the ordinary way with blood-serum and found positive. The cancerous tissue from these cases, procured at operation, was ground in

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TABLE 1.—CANCER CASES

No.	Clinical Diagnosis Cancer.	Anaphylactic Diagnosis	Confirmation.	Remarks
1	Uterus	Cancer	Microscopic	Inoperable.
2	Uterus	Cancer	Microscopic	Inoperable, test positive with cancer suspension.
3	Breast	Cancer	Microscopic	Advanced.
4	Tongue	Cancer	Microscopic	Operable.
5	Stomach	Cancer	Operation	Advanced.
6	Thyroid	Cancer	Course	.....
7	Uterus	Cancer	Microscopic	Late.
8	Stomach	Cancer	Operation	Patient died 6 months after operation.
9	Breast	Cancer	Microscopic	Incipient.
10	Lymph-nodes	Cancer	Microscopic	Test also positive with cancer suspension.
11	Breast	Cancer	Microscopic	Incipient.
12	Breast	Cancer	Microscopic	Operable.
13	Gall-bladder	Cancer	Operation	Cancer of gall-bladder spreading to liver.
14	Face	Non-malignant	Microscopic	.....
15	Palate	Cancer	Microscopic	.....
16	Breast	Cancer	Microscopic	Inoperable.
17	Breast	Cancer	Microscopic	Inoperable.
18	Tongue	Cancer	Microscopic	Incipient.
19	Sigmoid	Cancer	X-ray and course	Patient died 6 months after examination.
20	Breast	Cancer	Microscopic	Operable.
21	Uterus	Cancer	Microscopic	Advanced.
22	Stomach	Non-malignant	Microscopic	Incipient.
23	Breast	Cancer	Microscopic	Incipient.
24	Breast	Cancer	Microscopic	Incipient.
25	Stomach	Non-malignant	Microscopic	Late.
26	Intestine	Cancer	Operation	.....
27	Mouth	Cancer	Microscopic	.....
28	Breast	Cancer	Microscopic	Test also positive with cancer suspension.
29	Prostate.	Cancer	Course	.....
30	Gall-bladder	Non-malignant	Microscopic	.....

Number of cancer cases 30
Failures 4
Correct diagnosis 86.7%

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a mortar with powdered glass, emulsified with a small amount of salt solution and placed in an incubator for an hour. The suspension was then centrifuged and the supernatant fluid injected into guinea-pigs sensitized in the usual way. In all three cases the typical positive cancer reaction was obtained. Although no final conclusion can be drawn from these experiments, they certainly seem to indicate that the substance in the blood-serum in reality originate from the cancer tissue itself.

The twenty negative cases may be divided into the following classes: tuberculosis, 3; normal, 3; syphilis, 3; hypertrophic cirrhosis of liver, 1; myocarditis, 1; sarcoma, 1; gall-stones, 1; cirrhosis of the liver, 2; anemia, 1; jaundice, 1; acute intestinal obstruction, 1; intestinal stasis, 1; papilloma of the bladder, 1.

The most interesting classes of cases are the tuberculous, syphilitic and sarcomatous. There were three cases of tuberculosis; one of the peritoneum with tumor formation, one of the lung with enlarged bronchial glands, and one chronic suppurative cervical adenitis. The syphilitic cases were all of the tertiary type one syphilitic leukoplakia of the tongue, one syphilitic inflammation of the mouth and nose, one ulcer of the soft palate. The latter two cases gave positive Wassermann tests and yielded to salvarsan. The leukoplakia of the tongue gave a negative Wassermann. The leukoplakic patches were removed and microscopically showed the typical evidences of chronic inflammation.

CONCLUSIONS

1. From these tests it seems possible that the anaphylactic test may prove an aid in the early diagnosis of cancer. The five early cases, which gave positive tests, seem particularly significant.

2. The margin of error (8 per cent.) is not large enough to invalidate the test.

3. The most valuable single factor is the uniformity of negative tests in non-malignant cases. There seems

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TABLE 2.—NON-CANCER CASES

No.	Clinical Diagnosis	Anaphylactic Diagnosis.	Confirmation.	Remarks
1	Tuberculous lungs ..	Non-cancer	Tbc. bacilli in sputum...	.....
2	Myocarditis	Non-cancer	.....	.....
3	Normal	.....	.....	.....
4	Tuberculous peritoneum.	Non-cancer	Operation	Still living 2 years after operation.
5	Enlarged liver.....	Non-cancer	.....	All evidences of cirrhosis.
6	Gall-stones	Non-cancer	Operation	Gall-stones obstructing portal vein simulating cancer.
7	Cirrhosis of liver....	Non-cancer	.....	.....
8	Secondary anemia...	Non-cancer	.....	Cured by medical treatment.
9	Sarcoma of neck....	Non-cancer	Microscopic	Enormous lymphosarcoma.
10	Leukoplakia of tongue	Non-cancer	Microscopic	Patch removed; no recurrence after 1 year.
11	Syphilis of mouth...	Non-cancer	Wassermann positive.....	Cleared up under salvarsan.
12	Syphilis of palate...	Non-cancer	Wassermann positive.....	.....
13	Catarrhal jaundice...	Non-cancer	.....	Cleared up under medical treatment.
14	Cirrhosis of liver....	Non-cancer	.....	.....
15	Chronic intestinal stasis.	Non-cancer	.....	Cleared up under medical treatment.
16	Tuberculous cervical adenitis.	Non-cancer	.....	.....
17	Acute intestinal obstruction.	Non-cancer	Operation	Obstructed by band.
18	Papilloma of bladder.	Non-cancer	Microscopic	.....
19	Normal	Normal	.....	.....
20	Normal	Normal	.....	.....

Number of non-cancer cases..... 20
Correct diagnosis 100%
Total number of all cases 50
Correct diagnosis 92%

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no possibility of making a diagnosis of cancer, when cancer is not present.

4. A positive diagnosis seems absolute evidence of the presence of cancer.

5. This test needs further trial by other workers.

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ABSTRACT OF DISCUSSION

DR. OSCAR BERGHAUSEN, Cincinnati: In the ordinary case of cancer in which the tissue is accessible, the microscopic examination is sufficient, but when that is not the case some other means of diagnosis must be sought, such as the method described by Dr. Ransohoff. This method gives some promise of being a valuable means of diagnosis. The fact that 87.7 per cent. of accurate diagnoses were made in cancer cases is indeed most encouraging. It is very seldom that any method of diagnosis by clinical or specific means reaches that high rate. The change following the injection is very marked, as in a case at which I had the pleasure of being present. The experiments were all made at the laboratory of the Cincinnati Hospital, and several men made the observations to confirm those of Dr. Ransohoff. The test differs from previous tests along anaphylactic lines in that normal serum, as well as cancer serum, was used.

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SURGERY OF THE THYROID

OBSERVATIONS ON FIVE THOUSAND OPERATIONS

CHARLES H. MAYO, M.D.
ROCHESTER, MINN.

During the twenty-five years ending May 14, 1913, 5,000 operations were performed on the thyroid in the clinic at St. Mary's Hospital. These operations were done on various types of goiters and may be classified as follows:

Simple goiters	2,396
Including	
Transplantations in cretins	11
Operations for malignancy: carcinoma, 52; sarcoma, 7..	59
Operations on syphilitic thyroids	1
Exophthalmic goiters, including double and single ligation, extirpation, partial thyroidectomy	2,295
Early operations not classified, majority simple goiter	309
Total[1]	5,000

An increase in the size of the thyroid may be physiologic or pathologic. In the higher invertebrates the gland has a marked sexual relationship, and through this association we have a suggestion that the thyroid may be a factor in the manifest disturbances which occur at certain periods, especially in the female, as the well-known goiter of adolescence, the congestion of the thyroid during menstruation and its not infrequent enlargement during pregnancy.

While as yet we have no knowledge of a specific causative factor in the production of goiter, nevertheless a great deal has been learned during the past quarter of a century concerning the physiology and pathology of the

1. Ten aberrant, one accessory and one lingual thyroid are included in the total number.

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gland. Among its several functions the thyroid has been shown to be a *defense gland* and that it has much to do with physical and mental development. It is evident that increased activity of the gland is required during infections in different organs of the body. Several observers, among them McCarrison, believe this demand to be occasioned by intestinal toxemia, and that this may play an important part is undoubtedly true. The work of various goiter commissions and the reports of those observers who have made a study of the etiology of goiter make it quite apparent that, whatever the agent, it seems to be more readily conveyed by water than by any other medium, although water is probably not the sole carrier. The so-called goitrogenous water, when boiled, is not infective. Evidence varies as regards intestinal toxemia. Boiled water contaminated with the feces of an individual having recently developed goiter has produced goiter in goats, while the filtered residue of goitrogenous water from districts in which goiters prevail has also produced the same result in man and the goat. This does not necessarily prove a specific agent; it may indicate a demand on the system for increased resistance and greater elimination of toxic material. Repeated tonsillitis is another disease in which an infection may have a bearing on the hyperactivity of the thyroid.

The thymus gland and the thyroid are undoubtedly intimately associated in the growth and development of early life. We now know that the thymus is much more regularly persistent throughout life than it was formerly supposed to be and that not infrequently the gland may be of great size in advanced middle age, compressing the trachea at or just above its bifurcation. Such a complication is more common and more grave in late goiters of the serious hyperplastic type.

The occasional large goiter observed in the cretin has but little active parenchyma. If these goiters cause distress they should be removed. We have repeatedly transplanted gland from the mother, and also from fresh sim-

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ple and exophthalmic goiter. In none of these cases did the transplanted gland functionate, though for a short time it furnished secretion by absorption.

Changes in the voice are often caused by the presence of goiter. Large right-sided goiters quite frequently produce paresis of the left recurrent laryngeal nerve. It is therefore advisable to make a laryngoscopic examination before doing a thyroidectomy, which otherwise may be blamed for the paresis discovered later. Loss of voice through injury of the recurrent laryngeal nerve during operation is not a rare occurrence. Possibly 10 per cent. of patients have some temporary hoarseness, and about 5 per cent. a permanent difficulty with one cord, but without loss of voice. This percentage is small compared with the number of cases of paresis or paralysis due to the pressure of a goiter.

The left recurrent nerve, which is more frequently affected, lies slightly deeper than the right and has received more stretching during embryonic life. This may account in some measure for its greater susceptibility to injury from pressure. Extensive exposure of the nerve, as is done in some clinics, is necessary only in an operator's early experience, or in operating on nodular thyroids which extend beneath the trachea and which may have displaced the nerve. The scar tissue resulting from the traumatism of a too free exposure of a nerve may lead to secondary paresis.

Intrathoracic goiters and deep substernal goiters are of serious import and are found about once in fifty operations for simple goiter. Slight substernal projections are much more frequent. The diagnosis rests on (1) dull area on percussion, (2) the roentgenograph, and (3) evidences of substernal pressure (dilated veins, obstructive dyspnea and palpation of the upper pole of the gland just above the clavicle).

A special histology of the parathyroid glands was described by Sandstrom in 1880, and they have been the subject of much investigation and experimentation from a surgical point of view during the past few years.

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While a great deal has been attributed erroneously to the parathyroids, they are worthy of serious consideration by the surgeon operating on the thyroid. There are four parathyroids in the human being normally and, since the veins of these bodies have no valves, they are quite liable to imperfect development through congestive conditions occurring during birth. Inasmuch as but one or two of them may be active and their injury during operation may cause tetany, their location must be avoided by preserving the posterior capsule, especially when both sides of the thyroid are operated on. Because of the difficulty in identifying the parathyroids, it is best also to preserve all small gland-like bodies beneath or connected with the posterior capsule. Treatment, however, of operative tetany with calcium lactate and also beeves' parathyroid with thyroid extract has been very effectual. Our experience with this disease and treatment is limited to one mild case of temporary duration.

As regards the non-surgical treatment of goiter, there is no question but that many cases of simple goiter, especially of the adolescent type, undergo a natural resolution, which is also true of congestions and enlargements occasionally observed during pregnancy. In the hyperemic goiters of adolescence some form of iodin treatment may have a favorable effect. In encapsulated adenomas the use of iodin may manifest a temporary favorable effect on the surrounding gland, but the effect on the encapsulated tissue is uncertain. Its use between the ages of 35 and 60 seems to stimulate the activity of the thyroid and to cause degenerative changes. More recent experience in the non-surgical treatment seems to indicate the use of thymol, salol and iodin as intestinal antiseptics. The administration of thyroid gland has rather an uncertain effect, yet apparently produces favorable results in the early treatment of simple goiters. In a considerable percentage of cases, hyperthyroidism unquestionably is checked at various stages of the disease

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by natural or therapeutic measures. In exophthalmic goiters temporary improvement has been obtained by the use of the Roentgen ray, which seems also to be of value in carrying serious cases through exacerbations. The cytolytic serums for specific action on the thyroid have not borne out in their results the early expectations of the medical profession.

In operating on the thyroid, the best exposure to be obtained is through a transverse incision low in the neck, the skin and platysma turned together each way from the incision. Should further exposure be necessary, the sternohyoid may be sectioned high in the exposed area to prevent movement of the cutaneous scar and preserve a working muscle. In simple goiters it is best to extirpate a greatly enlarged lobe. If both lobes are symmetrically enlarged, division of the isthmus with double resection of the gland is indicated for the best cosmetic results. Midline encapsulated adenomas should be enucleated with division of the isthmus. Lateral encapsulated adenomas may be enucleated or the whole lobe extirpated.

If symptoms of hyperthyroidism are present, extirpation is indicated. In severe cases of hyperthyroidism, in acute attacks and relapses or exacerbations, the condition should be considered medical until improvement takes place. If no improvement proves manifest under such care, injections of boiling water into the lobes (Porter) may give relief.

During the first three or four months of the symptoms extirpation can safely be made since the heart then is not dilated. If dilated to exceed 1 inch, primary ligation of the superior thyroid vessels is indicated, followed in four months by extirpation. After the first year a much smaller percentage of cases requires primary ligation. A single test ligation on one side may be made in doubtful cases, to be followed in a week by a second ligation or partial extirpation according to the degree of reaction.

The records of a large number of patients in this series show an average gain of 22 pounds within four

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months after ligation. These patients were then operated on, a partial thyroidectomy being done with safety. Following these methods of safety, we have performed 278 operations on cases of hyperthyroidism between deaths. Long-standing cases of simple goiter and adenoma may, by degeneration or chronic slow thyrotoxicosis, cause serious disturbances in the heart, kidneys and blood-vessels. Especially is this true of patients in middle and advanced middle life. When such complications are present operations are made with considerable risk.

Excluding malignancy, the mortality in operating on goiters is very low. It varies but little at present in the cases of so-called simple goiter, in which class are included occasional complications, from the cases of so-called exophthalmic goiter with hyperplastic glands. In the early development of surgery, operations on exophthalmic goiters were delayed until serious complications arose with the heart, kidneys or nervous system. This led to a high mortality, which naturally deterred physicians from sending patients to surgeons for early operation. The greater the delay the greater the mortality—hence a surgical vicious circle. Our mortality in the first sixteen cases (which were, of course, advanced) was 25 per cent.—about the average percentage in other clinics at that time. The mortality at present varies from 1 to 3 per cent. This great reduction in mortality is probably due less to operative skill and technic than to better judgment as to the time and extent of the operative procedure instituted, as well as to the skilled use and rational choice of an anesthetic. The various causes of mortality are hyperthyroidism, embolism, pneumonia, hemorrhage, sepsis, etc.

The results of operating on simple goiters are well known to be exceedingly satisfactory. Severe myxedema is but a rare complication following such operations, especially if the area of the gland nearest the capsule be preserved. The large colloid masses in the interior of these glands represent the great bulk of the tumor but the least amount of the working area of thyroid tissue.

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Operation in cases of hyperthyroidism appears to give about 75 per cent. of cures, while the remaining 25 per cent. are more or less benefited, according to the degree of complication and the stage of the disease. Probably 10 per cent. have some degree of relapse in from one to three years after operation, usually manifested by the return of symptoms. In these rare cases further operation by ligating the vessels, and in most cases by removal of a portion of the remaining lobe, improves the condition of the patient by reducing the amount of thyroid secretion. Exophthalmos of marked degree and long standing may still be present when other symptoms are cured. This is due to the gradual contraction of the non-striated muscle which sustains the globe to the anterior supporting orbital fascia (Landstrom). In some cases we have greatly improved this condition by removing the superior and middle sympathetic ganglions.

If the patient is in a good general condition without complicating conditions, a general anesthetic, for instance, ether by the drop method, is preferred. Ordinarily patients receive 1/6 grain of morphin and 1/150 grain of atropin half an hour before the operation. Nervous patients having exophthalmic goiter may receive 1/200 grain of scopolamin one hour before operation, but without the atropin unless a general anesthetic is also to be given. Scopolamin is uncertain in its effects, some patients being made worse by its use. Patients suffering from grave complications rendering general anesthesia inadvisable can be carried through extensive operations by free local injections of novocain, 0.5 per cent.; and a combined local and general anesthesia, as advocated by Crile, may be of advantage in many cases. Intratracheal anesthesia is indicated in those cases of scabbard or distorted trachea in which the patient is already suffering from dyspnea, or more especially in those suffering from malignant disease of the thyroid, and complications due to enlarged thymus.

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ABSTRACT OF DISCUSSION

DR. GEORGE W. CRILE, Cleveland: I can confirm Dr. Mayo's conclusions by my own experience, having operated in over 800 cases of goiter of all types and varieties. I have never seen a single case in which cancer of the thyroid diagnosticated before operation was cured by operation. I have seen a few cases in which cancer of the thyroid, not suspected before operation, but found by the pathologist, was cured. The safety of the operation for colloid goiter is so great at the present time that, if the patient demands operation, one is justified in removing the gland for cosmetic reasons. The care Dr. Mayo suggested in the preservation of the voice is excellent. I have found that one may take out the entire lobe, by carrying the dissection to the edge of the capsule, using very small hemostats and keeping a bloodless field so that one can see from the beginning to the end of the operation the lymph-vessels as they run out of the gland. This technic makes it possible etiher to remove a parathyroid or to injure the recurrent laryngeal nerve. Passing to another subject, I wish that a commission might be appointed for the purpose of investigating the adolescent period of children living in goitrous districts. I believe that the syrup of ferrous iodid in 5-minim doses, three times daily, for periods of a month during every year, will control nearly all cases of simple hypertrophy. One of the factors in the production of adolescent goiter lies in the geologic change in the constituents of the earth whereby iron is not found in the food as once it was. I find that clinically one can make a very accurate prediction of the pathologic condition to be found in the gland. There is no more doubt in my mind as to the benefits of operation for exophthalmic goiter than there is of the benefits of opening an abscess. Patients confirm that view, and our clinics have grown not through reference by physicians but through reference by patients. Nowadays, I believe that there is a general feeling not only among surgeons but also among patients that exophthalmic goiter is a disease that should not be allowed to go on until the stage of degeneration is reached. I believe that the late results of the disease are largely under control. One can operate now and control the hyperthyroidism by the principle of anoci-association, and not have a single change for the worse at the end of the operation, no matter how severe the case, how large the gland or how rapid the pulse-beat. That is, postoperative hyperthyroidism is eliminated.

DR. A. J. OCHSNER, Chicago: The enlargement of the thyroid is primarily a physiologic condition. There seems to exist a certain balance between the amount of thyroid secretion and the amount of secretion that is needed by the human organism for the purpose of carrying on its physiologic work. When there

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is an unusual strain on the physiologic activity of the body, the thyroid seems to prepare for it. This occurs especially when there is to be produced a large amount of new tissue of a highly organized character, or of the bony framework, as for instance during pregnancy. There may be a physiologic increase in size of the thyroid or an increase in weight. The same may be true during the period of puberty. There is an increase in the size of the pelvic bones, and other changes in the anatomy of the girl are followed by an increase of the thyroid. We have another interesting example brought out by Professor Wilms, who found that the students coming to the university from hyperthyroid countries developed hyperthyroidism a short time after their arrival at the university. It seemed as if the thyroid had to produce an additional amount of secretion so as to make it possible for the person to get his growth under the handicap placed on him by the presence of certain substances in the water which he drank. When the young man goes to the university where the water does not contain these, where the thyroid must supply the substances and overcome this handicap, he develops hyperthyroidism. As soon as the boy goes home and drinks the water there, the hyperthyroidism promptly disappears. Some of the water from a town where 70 per cent. of all the inhabitants had goiter was given to rats. Every normal rat which drank this water for a period of weeks developed goiter. This water was boiled and given to other rats and did not produce enlargement of the thyroid. Something in the water had been changed. One of Wilm's assistants, who came from this town, gave water from across the valley to children there; these children did not have large thyroids. The children born on a certain farm did not have enlargement of the thyroid, but those who were born later into the same family, on a new farm, all had enlargement of the thyroid. The water was boiled and there was no more enlargement of the gland. Instead of giving iron or iodids, I would boil the water.

We must not lose sight of the physiologic side of this question. When the calamity has occurred, we must relieve the condition surgically before it has been destructive in its action, because, as Lundstrom demonstrated in the examination of all his cases, once the destruction has occurred, it is permanent. The removal of the enlarged gland then simply stops the progress of the condition. The patient from that time on simply suffers from the destruction that has already occurred, and of necessity what has been done by operation simply frees him from the continuation of this poisonous action and gives whatever is left of his tissues a chance to do the best they can.

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DR. CHARLES H. MAYO, Rochester, Minn.: Dr. Crile called attention to a very valuable point, namely, that we have enough cases of goiter now all over the country to warrant the appointment of a goiter commission. In carrying on that work we ought to have the active cooperation of surgeons, pathologists, internists and physiologic chemists, to see whether this question cannot be threshed out by having such a group of men at work on it, each one working on a series of cases, so that we could get something before this Section to guide us in our further work. Switzerland has had two or three such commissions, and the Indian government also has such a commission, which has already done an enormous amount of work. There is no doubt that goiter is toxic, but toxic as alcohol is toxic to the blood-vessels and to the heart. When a patient (usually a woman) has suffered for twenty or thirty years from colloid goiter, she begins to think about the goiter. She consults a physician and he starts to treat her with iodin. In six weeks or three months she thinks that the goiter is smaller, but the doctor changes his indication for treatment from goiter to myocarditis or endocarditis. So much can be done by treatment in overstimulating the gland which for twenty or more years could not give the necessary secretion. Nature has fortunately endowed us with enough glands so that we can spare a few. Take out one kidney or even half of the remaining kidney and still that half of a kidney will do the work. We can get along with one tenth of a pancreas, but that does not mean that we have too much kidney substance or too much pancreas substance. It simply means that Nature can accommodate herself to a certain extent so that a part of a gland can do the work of a whole gland. Take the high-school girl who is overworked, whose general condition is bad from overexcitement. She is very nervous; she receives a sudden shock. She has been struggling with an oversecretion of the thyroid trying to neutralize certain poisons, and following the shock she develops in a few weeks a severe grade of exophthalmic goiter. Due to what? To a product of the sympathetic nervous system previously controlled. It did not come on suddenly. It suddenly became acute. That is all. It had been there for a long time. It made her nervous and the shock made it acute.

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STUDY OF THE COLLATERAL CIRCULATION IN SOME CASES OF SPONTANEOUS GANGRENE OF THE FOOT[1]

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When disease interferes with the volume of blood which passes along an artery, the tissues which its terminal branches supply receive less blood than they have been accustomed to. An urgent call passes to the central nervous system, which results in the dilatation of the collateral channels.

On the ability of the collateral channels to carry sufficient blood to the parts demanding it depends their life. It is almost a universal rule that physiologic processes are more than adequate to meet emergencies, for Nature has been generous in this respect; so we find that in the majority of cases arterial blood passes around the obstruction without difficulty and that the peripheral tissues do not suffer materially from the loss of their direct blood-supply.

When the blood-vessels of a limb are healthy, occlusion of the main artery at any one point is rarely followed by more than a temporary anemia of the periphery, and if care is taken in the selection of suitable sites the blood flows through the collateral channels so vigorously that the tissues barely suffer at all. On all the large arteries of the limbs these sites exist, as, for example, the third part of the subclavian and the brachial artery at its middle for the upper extremity; and the external iliac artery and the femoral artery in Hunter's canal for the lower extremity.

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Accurate knowledge of the subsidiary or the collateral circulation is scarcely of less importance than that of the direct. Under ordinary circumstances, when the arterial system is healthy and normal, the subsidiary channels dilate the moment the main channel is obstructed and the blood is carried by them to the periphery so expeditiously that the process is taken as a matter of course. An assumption on the part of the surgeon that the collateral circulation is adequate is unwarranted, and his confidence is often rudely disturbed by disastrous results that occasionally follow some of the routine ligatures of arteries. It is just as necessary for him to be acquainted with the position and patency of the accessory channels as it is for the head of an irrigation farm to know all about his system of irrigation ditches. It is unpardonable to assume that the collateral circulation is competent without making sure of its state of efficiency.

In some regions of the body, for example the arm and leg, these tests can be carried out with a fair degree of accuracy. Thus the arm can be rendered bloodless by being wrapped with an Esmarch bandage. If a tourniquet is now fastened on the upper part of the arm below the axilla the Esmarch bandage can be removed and the limb will still be bloodless. The brachial artery is now compressed against the humerus in such a manner as to obliterate its lumen, but not to stop the collateral circulation, and the tourniquet is removed. If the collateral circulation is competent blood will be seen to pass slowly from above around the obstruction until it finally reaches the finger-tips.

The same test can be applied in the thigh, pressure being applied to the femoral artery in Hunter's canal. In most of the other regions of the body either compression tests such as these are impossible, or it is not feasible to press on the main artery without at the same time exerting pressure on the collateral circulation, so stultifying the results. Under such circumstances it

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is unjustifiable to ligate the artery boldly and to trust to luck; it is preferable to expose the main arterial trunk by an incision and compress it temporarily by some form of apparatus which will obstruct the lumen. Of the various means that have been employed to accomplish this the simplest seems to be the aluminum band used by Matas. This consists of a flat strip of metal which can be passed around the blood-vessel like an aneurysm needle. The sides of the bent portion are then pressed together between the finger and thumb and the walls of the artery are mechanically brought in contact. (Experimentally, it has been found by Matas and Allen that it is possible to compress a vessel to the point of obliterating the pulse and to maintain the pressure for from three to four days before obliterative endarteritis occurs.)

If the pressure on the walls of the artery has not been excessive no harm is inflicted on the intima, and clotting does not occur. If serious symptoms make their appearance owing to inadequate collateral circulation, the bands can be removed and direct circulation reestablished.

Not only should we have proof that the collateral channels are physiologically competent, but we must know all about them from an anatomic point of view. A few concrete examples will illustrate my meaning:

1. In aneurysms occupying the popliteal artery the obstruction to the direct flow of blood through the main artery is often so complete that the limb is dependent almost entirely on the collateral trunks, namely the upper sural and articular arteries above, and the lower sural and articular arteries below. These collateral channels are in close proximity to the aneurysmal sac, and as the aneurysm enlarges, direct pressure is often made on them with disastrous results (gangrene). These facts should be weighed carefully in the choice of radical operations on aneurysms. The proximity of the collateral channels to the sac wall renders them easily liable

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to injury during the operation of excision. This operation will thus be seen to be much less safe than the "old operation of Antyllus," and much less desirable than the modern operation of Matas (obliterative endoaneurysmorrhaphy).

2. In ligature of the common iliac artery, great care should be taken not to injure the deep epigastric artery, which is one of the important anastomotic channels carrying blood to the lower extremity. If the transperitoneal operation is performed, it would be safer to make the abdominal incision in the median line and not through the rectus muscle. The same precaution as to injury of this artery should be used in ligature of the external iliac artery, in which the retroperitoneal method is usually employed; although here the anastomoses between the branches of the internal iliac and those of the internal circumflex are usually adequate.

3. In operations on the axilla which may result in obliteration of or removal of a segment of the axillary artery (for example, the old operation on axillary aneurysm or operations for the removal of axillary tumors), one should be careful to preserve from injury, the subscapular artery as well as the lower portion of the axillary vessel from which it arises. The main part of the collateral circulation comes along this trunk from the scapular anastomoses.

4. In operations on the intestines or during the removal of tumors from the mesentery, the course of the blood-vessels must be carefully noted. An accurate knowledge of their situation, and attention to the arrangement of the anastomosing loops, will often permit ligatures to be placed without endangering the circulation of the intestine, and will allow the removal of some tumors without resort to enterectomy.

In extensive operations on the rectum and sigmoid flexure the same careful selection of sites for ligatures will enable the surgeon to straighten out the intestine

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and render it so mobile that the sigmoid can often be drawn down to a sacral anus without interfering disastrously with its vascular supply.

With these introductory remarks, I will pass at once to the fundamental object of my paper, which is to present a few interesting facts concerning the collateral circulation in spontaneous gangrene of the lower extremity.

I have chosen three cases of gangrene to illustrate it, one of Raynaud's type, the other two of the senile form.

REPORT OF CASES

CASE 1.—Man, white, aged 39. Spontaneous gangrene of the big toe of the right foot. Clear history of temporary ischemic attacks for at least a year before the appearance of the gangrene. Onychia appeared and the nail was avulsed. Gangrene appeared in the matrix and spread very slowly, advancing by fits and starts, and taking about four months to reach the metacarpo-phalangeal joint. Suddenly the circulation of the four outer toes was threatened and the patient consented to amputation.

Operation.—At the patient's request a disarticulation through the knee-joint was first made. The popliteal artery was completely blocked up with partially organized clot. A second amputation through the lower third of the thigh was made at once. The femoral artery at this level was filled with soft recent clot which was picked out with forceps. After the tourniquet was removed the ligatured femoral artery pulsated fairly vigorously and the terminal branches of the profunda femoris bled very freely. The amputation stump healed by first intention.

Dissection.—1. The femoral artery at the site of the upper amputation was filled with recent clot which could be removed easily.

2. The popliteal artery was completely filled with old standing partly organized clot.

3. The anterior tibial artery was atheromatous but was patent and contained no clot. All the blood passing to the foot had coursed along this vessel.

4. The posterior tibial artery was completely obliterated, being filled with a solid mass of completely organized clot apparently of months' standing. The anastomoses around the knee-joint had been so disturbed by the double amputation that an accurate dissection was impossible. The upper and lower sural arteries were found wide open.

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CASE 2.—Man, white, aged 71. Diabetic gangrene of the right heel of six months' standing. The gangrenous process was extremely indolent and had remained stationary for at least two months. The patient suffered from great pain in the part. There was marked atheroma of all the peripheral arteries. The urine was loaded with sugar.

Operation.—Under spinal anesthesia (stovain), an amputation through the lower third of the thigh was made. The femoral artery at the point of section was blocked up with a firm organized clot of long standing. After the tourniquet was removed the flaps were completely dry. Not a single ligature was applied to any vessel except the femoral vein, which was wide open. In spite of this the flaps lived and united by first intention. Just a week after the amputation the patient passed into diabetic coma and died.

Dissection.—1. The femoral artery at the line of section was completely obliterated.

2. The popliteal, below the origin of the upper sural arteries, was small but quite patent. It was patent as low down as the bifurcation into the anterior and posterior tibials.

3. The posterior tibial was thrombosed and unable to transmit fluids. The thrombus was partially organized.

4. The anterior tibial had a patent lumen along which fluid could be forced easily. It was atheromatous.

CASE 3.—Man, white, aged 63. Diabetic gangrene of the right big toe and the contiguous parts of the sole of the foot. The gangrene was of the dry variety and practically stationary.

Operation.—Amputation through the lower third of the thigh under spinal anesthesia (stovain). The femoral at the point of division was almost obliterated. It contained no clot, but the walls were very much thickened and the lumen was very small. After the tourniquet was removed only a very thin trickle of blood escaped from it. The terminal branches of the profunda femoris bled freely.

Dissection.—1. The popliteal below the origin of the upper sural and upper internal articular arteries had a fair-sized lumen much larger than that of the femoral. This continued patent as low down as the bifurcation.

2. The posterior tibial was very atheromatous; its lumen was very small but fluids could be forced down it.

3. The anterior tibial was unusually large, very atheromatous and calcareous and the lumen was seriously narrowed.

RELATION OF FINDINGS TO THE CLINICAL SYMPTOMS

It is interesting to analyze the pathologic findings and to link them as far as possible with the clinical symptoms presented:

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The actual appearance of the gangrenous onychia in Case 1 had been preceded for at least a year by attacks of local ischemia, shown by intense pain in the foot, cramps in the calf muscles and blanching of toes and foot. During this time it is probable that the circulation along the posterior tibial was becoming seriously embarrassed on account of the advancing arteritis. The actual onset of gangrene seemed to result from traumatism after removal of the nail. Even then the process was exasperatingly slow, four months elapsing before the whole toe became gangrenous. During this period blood was still reaching the foot and outer toes along the patent anterior tibial. The latter days of the affection were attended with threatening gangrene of the outer toes. This condition probably coincided with the obliteration of the popliteal artery by clot, which prevented any blood from reaching the lower extremity except that passing between the anterior tibial artery below and the anastomoses around the knee-joint above. The path of the blood around the obstructed femoral and popliteal vessels must have been by way of the terminal branches of the profunda femoris anastomosing with the upper sural and articular arteries, the latter with the lower sural and articular arteries, and these again with the anterior tibial recurrent branch. The path was so tortuous and the channels so narrow that a mere trickle of blood passed through, and as the case showed, gangrene was inevitable.

Gangrene affected the soft tissues of the heel and part of the os calcis in Case 2. The posterior tibial artery was completely blocked. The anterior tibial was patent.

In Case 3 the gangrene affected the big toe and a small contiguous part of the sole of the foot. Here the anterior tibial artery was unusually large although the lumen was narrowed. The posterior tibial was almost obliterated.

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In either of these cases a high blood-pressure and a full current of blood from above through the femoral and popliteal would probably have been sufficient to force the blood along the patent vessels to the extremity. But in each case the current from above in the femoral was obstructed. The femoral artery was totally obliterated in Case 2 and blood was reaching the popliteal by way of the profunda femoris and the upper sural and articular vessels, thence passing into the patent anterior tibial. In Case 3, although a very small lumen was present in the femoral artery, the greater part of the blood passed into the popliteal and tibials by means of the same chain of anastomoses. It is evident that all blood reaching the tibials under such circumstances must carry so low a tension that the capillary circulation would be very sluggish, and sooner or later gangrene would be inevitable.

METHODS OF ASCERTAINING CONDITION OF ARTERIES

From the study of such cases the query naturally arises, Have we any means of finding out the exact pathologic state of either the anterior or posterior tibial arteries, as to the presence of atheroma and their respective capacities as carriers of blood? There are no absolutely accurate methods. Much must be a matter of surmise. The position of the gangrenous area, as of the heel pointing to obliteration of the posterior tibial artery in Case 2, or gangrene spreading along the plantar aspect of the foot while the dorsum is free, or vice versa, may be a valuable aid. Roentgenoscopy would enable us to picture the calcification of the arteries, but we often find the lumen of such arteries absolutely patent.

It is impossible to use pressure on either of these blood-vessels near enough to their origin to enable us to find out whether the circulation of the limb is carried on by one or the other or by both equally. Either vessel can be compressed just above the ankle and a certain degree of information obtained. It would be difficult,

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however, to apply accurate pressure above the upper malleolar branches, a necessary precaution if we wish to cut off all connection between the two vessels.

Can we find out whether the popliteal artery is patent? In Cases 2 and 3 the popliteal artery was patent although the femoral artery, at the site of amputation, was practically obliterated.

As described earlier, by driving all blood from the limb and putting pressure on the femoral artery in Hunter's canal before the tourniquet is released from the upper part of the thigh, the competence of the collateral circulation can be determined beforehand. This method, however, is a test of the collateral circulation as a whole and gives us no idea of the competency of its various factors. Blood may reach the toes, without passing along the popliteal artery, by way of the profunda, the upper sural and articular branches, the lower sural and articular and the tibials; and in the cases of popliteal aneurysm this is the usual path. In cases of atheroma it is probable that the popliteal artery remains open for quite a long period to meet the exigencies of the occasions as in our Cases 2 and 3.

At the present time we can only make a shrewd guess at the exact pathologic state of the blood-vessels, and on this account the treatment of actual and impending gangrene of the lower extremity is unsatisfactory.

CONCLUSIONS

The question of amputation is a knotty one to decide, both as to time and as to location. The plan of waiting is satisfactory as a rule, provided one is prepared to deal radically with the case if it does not halt. I am firmly convinced that the empiric rule of the old surgeons is based on correct principles: "Avoid amputation if possible, but if it is inevitable amputate high, that is, through the lower third of the thigh."

When careful dissections of the arteries are made, marked atheromatous changes will be found invariably

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in one or both tibials and in the popliteal and femoral also. As it is impossible to be absolutely certain as to the patency of these vessels, the risk of amputating through tissues supplied by diseased arteries is too great to be encountered. We can assume as a probable certainty that one or both tibials is obliterated or seriously obstructed; consequently amputation of the leg is to be shunned. Although in many cases the popliteal artery is patent and forms the main channel by which blood is carried from the upper anastomotic channels to the tibials (the femoral often being blocked, as in Case 2), it is unsafe to trust the future of an amputation stump (say of a knee-joint disarticulation) to such a precarious blood-supply.

It is much safer to amputate through the lower third of the thigh where the flaps are well nourished. At this level, even in cases in which the main femoral trunk is obliterated, the flaps are usually well supplied with blood derived from the muscular trunks of the profunda femoris.

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ABSTRACT OF DISCUSSION

DR. CHARLES W. ALLEN, New Orleans: I have been interested particularly in the Matas hyperemia test and the Matas aluminum band, having worked them out with Dr. Matas.

DR. W. W. GRANT, Denver: It seems to me that two or three points are of very great importance in the discussion of this paper. First in importance is the point of amputation, or I should say, the degree of amputation that should be done. I recognize the fact that it is customary to amputate at as high a point as possible in case of gangrene of the foot or leg, if it is desirable to amputate at all. In cases of moist or wet gangrene due to infection, one should not wait for the line of demarcation. To amputate is the only thing to do in these cases. Ordinarily this is true of idiopathic gangrene but not of senile gangrene. I think that we ought to conserve as much of the limb as possible. The age of the patient and the etiology of the gangrene, whether it is due to infection or trauma, must always be considered in determining the question of amputation. I do not think that in cases of trauma of the foot, causing gangrene, we are justified in

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amputating above the knee. We ought to leave enough of the leg below the knee so that the patient will have a good stump for an artificial limb. That is a matter of great importance to laboring men. In fact, it is a matter of a good deal of importance at any time whether or not we should amputate above the knee in any case short of total death of the tissues due to infection of the leg below the knee. Ordinarily we can rely on the blood-vessels to produce in time a collateral circulation that will maintain the integrity of the remaining portion of the limb or a good part of it. In cases of hemorrhage or damaged blood-vessels, one should amputate in the absence of gangrene. In the acute infections with gangrene, one should also amputate.

DR. J. E. THOMPSON, Galveston, Tex.: My remarks were intended to apply to gangrene from disease, namely atheroma. I find it difficult to make up my mind when and where to amputate. I have known of three amputations done, one at the ankle, one below the knee and the third at the middle of the thigh. I shall hesitate still more and more about performing an amputation below the knee until I am absolutely certain about the condition of the vessels, which at present I am not.

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THE QUALIFICATIONS OF THE SURGEON

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Almost incredible progress has been made in surgery during this wondrous age. The amplification of its uses would be a source of consternation even to our immediate forefathers.

The ever-widening scope of diseased conditions amenable to the beneficences of surgery has brought into requisition a large number of men and a high degree of excellence. No vocation, in fact, demands a higher type of endowment than that of the surgeon.

Can there be any more brilliant achievement than the conquering of the inveterate sufferings, the fatal wounds, or the deadly diseases that lie ensconced in the intricate and almost inaccessible recesses of the human body? It is a hazardous invasion and requires the utmost skill and intrepidity. Any man who has the capabilities and varied faculties that go to make a successful surgeon could so much more easily succeed in some other avocations. He must be a great scientist and a great student whose studentship must continue. Finney has well said: "The science of surgery will always overshadow the art, and unless one is well-grounded in the principles of true scientific surgery, it must degenerate into something of a trade or a sort of sleight-of-hand performance." When the arduous scientific side is mastered, the surgeon must also become a great artist. In pure art all that is essential is the spark of genius. Application does the rest. The surgeon in addition to being a scientist must needs be a

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highly trained technician. Above all there should be the great heart and impulses of the man.

Celsus, the illustrious Roman, declared that a surgeon should have a firm and steady hand, a keen eye, and the most unflinching courage, which can disregard alike the sight of blood and the cries of the patient. This applied to the physical and temperamental needs of the man during the infliction of great pain on the conscious patient.

Now we have blessed anesthesia by which "the fiercest extremity of suffering has been steeped in the waters of oblivion and the deepest furrow in the knotted brow of agony, has been smoothed away forever." (Oliver Wendell Holmes.) Surgery is concerned not only with grave wounds and injuries, but with myriads of diseased conditions, from those of the new-born babe to those of extreme old age. Women and children are especially in need of its beneficences. The surgeon should, therefore, be a man of the broadest and tenderest sympathies, and one whose kindliness and gentleness are unfailing. "Be ye wise as serpents, gentle as doves." The era of extreme delicacy in the handling of tissues and gentleness of manipulation has come. These are perhaps after all the most important principles of anoci-association.

Can any one fathom the responsibilities of the surgeon? There is scarcely a time in his busy life when he is not confronted with some exceedingly disquieting and all-absorbing case, and no long space of time but measures some appalling disaster that embitters the great service to which his life is consecrated. That great and sound man, Maurice Richardson, whose recent death has bereaved not only New England, but the entire guild of surgeons throughout the world, measured up more than any man of his time to the enormous responsibilities of a surgeon's life. He said in all sincerity:

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The surgeon reviewing his active years of practice cannot but be impressed by the responsibilities of his profession. He recalls the frequent misgivings with which, on the strength of his fallible opinion, he has advised and performed operations; the excitement of a critical operation and the deep breath of thankfulness when he has succeeded in averting some grave complication; his forebodings become realities; the too often useless struggle against overwhelming odds; the distressful death; the severe self-criticism and biting regrets. And is not the surgeon, appreciating his own unfitness in spite of years of devotion, in the position to condemn those who lightly take up such burdens without preparation and too often without conscience?

The first great requirement of the surgeon is a conscience. It should be his constant mentor and the great arbiter of those momentous decisions which come daily to those who combat disease and death and whose efforts are so far-reaching in the preservation of life and in the science of humanity.

In no spirit of vaingloriousness be it said that American surgery at its best represents the very highest type of that art in the civilized world. The surgeons of this country, who are in their prime to-day, represent the pioneers of the new surgery. They are the first generation of men who were educated in the antiseptic era. Their experience has been unprecedented. Much of the newer work has been created by them and has practically all been evolved since their student days. They have been pathfinders. They have had all of the hardships of the early settler. Ambition, resourcefulness, hardihood, adaptation and a devotion worthy of their great calling have made of the active and seasoned men of to-day the brilliant, but practical, intrepid and cautious American surgeons. Taught in the hard school of experience, is it not the duty of this courageous band to plan for the education of the future surgeon? Has not the time come in the evolution of our art when certain requirements should be made; certain qualifications demanded; certain training prescribed to the end that loftier ideals may be established, more perfected

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and efficient work accomplished and for the fame of American surgery an inextinguishable lamp be lighted?

There is no denying that much of the surgery being done is extremely ill-advised and miserably executed. I am keenly alive to my own shortcomings, and in spite of a fair degree of opportunity and a number of years of more or less diligence, realize how far short I fall of the ideals herein to be expressed. My house is one of such complete transparency that I hesitate to cast a stone. The criticisms, however, are intended as purely constructive.

The increased amount of operative work at this day and the ready acquiescence of individuals who know what has been accomplished enables many general practitioners untrained in surgery and many young men without the leavening experience of general practice to essay the perilous rôle of the surgeon.

Hospitals make the same preparation for all operators alike. With aseptic precautions and rubber gloves many men are able to invade the abdominal cavity and tissues within the body without actually destroying the life of the patient. The mortality, while very much greater than it should be, is not absolutely forbidding, but the morbidity is really incalculable and the results are often valueless if not permanently disabling. Comparatively benign invasion of structures is only the beginning of surgery. Any house surgeon should be able to do this. Cure with a minimum of risk and a maximum of results should be the end and aim. As Finney has said "None knows better than the experienced surgeon how far-reaching are the possibilities for good or evil lurking behind every surgical procedure." Therefore, the indication should be exceedingly clear, the need great and all of the safeguarding and exacting conditions fulfilled. The unnecessary operation is the crying shame of present-day surgery. These are performed by the operator, not by the surgeon. There is a vast distinction between an operator and a surgeon. There are many of the former but few of the latter

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class, comprehending as it does men of saneness, probity and judgment. How difficult is the acquisition of surgical judgment! Judgment is the queen of mental attributes in the ordinary affairs of life; but how all-important and responsible is the exercise of that judgment, even if acquired, when brought to bear on the health, the limb and life that is so trustingly and confidently placed in the hands of that man who alone can restore it!

Would that another Senn could arise and rebuke us for our furore to do surgery. It would indeed require the stentorian voice of a great leader to stem the tide of the unnecessary surgical operations of our day. Is it not a castigation when a humorous periodical says, "If you go to the doctor's office sufficiently often, you will be operated on?" This is the result of many contributing factors; bad judgment, inexperience, an overweening desire to do surgery, the ease and facility with which all of the drudgery can be avoided in the hospital, the surgical exploitation of the neurasthenic and, lastly, let it be sorrowfully said, the commercial spirit which has raised its hydra head in all its monstrousness among us. Would that it could be cast out! It must be! yea, it will be, and largely by the individual and united efforts of the members of the Section on Surgery of the American Medical Association.

Nebraska has passed a law making it a penal offence for a commission to be offered or accepted, or for fee-splitting to be practiced in any form. Every state should have such a law, unless the profession can clean its Augean stables within its own ranks.

The most dangerous operator is not the enthusiastic beginner, because he will learn; not the antiquated back number, because he will die; but it is the occasional operator, the general practitioner without special training and the young man whose only preparation consists in the ordinary undergraduate work of the average medical college.

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As the Nestor of surgery in this country, Halstead, that great teacher, has said, in his memorable address on "The Training of the Surgeon," the interne "suffers not only from inexperience, but also from overexperience. He has in his short term of service responsibilities which are too great for him; he becomes accustomed to act without preparation and acquires a confidence in himself and a self-complacency which may be useful in times of emergency, but which tend to blind him to his inadequacy and to warp his career."

Unfortunately, a great deal of serious surgery is attempted by men with the most meager opportunities and the frailest ability. It is as cheap to prepare to be this kind of a surgeon as to follow any other line of medicine and it is attractive not only to the purely ambitious, but to the avaricious. It is not a question of the patient's well-being, but the commercial value of the patient; one might almost say the commercial value of human life.

It is an exceedingly difficult matter for any one of us to appreciate our limitations. Is it not a fact that the surgeon in one field who takes cases in a remote field with which he is not familiar is more guilty than the practitioner who occasionally does some simple form of surgery, although not quite so well trained to do it as the surgical specialist?

Dr. Stuart McGuire has said, "No conscientious surgeon should undertake an operation without asking himself whether he has the skill to do the work satisfactorily."

The great middle class are the greatest sufferers from surgical delinquencies. The poor are safeguarded by their poverty, which necessitates their going to the charity clinics. These are as a rule competently manned. The rich are protected by their knowledge and cultivated habit of seeking the best. It is the large middle class, who are able to pay moderately for what they get and who think one doctor is about as good as another, that get the most indifferent service.

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The multiplication of the small hospitals in the smaller cities and towns has undoubtedly ministered to many sufferers in a satisfactory manner. After all, the size of the town does not matter, but the size of the man does. If one man in a community can by natural aptitude, innate ability and good training establish or be put at the head of a well-ordered hospital, the character of the work will be high. Such a man will command the cooperation of his confréres. It is a distinct mistake, however, to encourage four or five men in a town where there are from six to twelve practitioners to believe that each one can do the surgery that may come to him. They do not or cannot have a sufficient number of serious cases to make them all competent, even granting they have the ability and previous training. It is a mistake for a young man to go out with his one year's experience in hospital work and give out the statement on his cards and otherwise that he is to do surgery exclusively. If young men are permitted to enter surgery without experience or training and to say that they will displace their elders, still other young men will come on and displace them, so whether the surgical work comes early or late it will last only for about the same period of time. The objection to adequate preparation on the ground that the surgeon will be an old man before he starts is not valid.

As Halstead says:

> The faults of our system of educating surgeons begin almost at the bottom and continue to the very top. I am considering only the training of the best men, those who aspire to the higher career in surgery. On graduation they become hospital interns, but their term in the hospital is only one and a half, occasionally two years, only a little longer than the term of hospital service required in Germany of every applicant for the medical degree, and not so long, on the average, as that required of each medical graduate of the University of Tokio.

The foundation for improved conditions in our profession must be in more efficient education. In less than ten years the Council on Medical Education of the

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American Medical Association has done a prodigious work. The Council found that in this country there existed 166 medical colleges, which was one less than existed in the remainder of the civilized world. As a result of the investigation, classification and publication of the work of this council, sixty-five of these colleges have been merged to make stronger ones, or have become extinct. Many of this latter type were a disgrace. There are about 112 medical colleges in the United States now. When we realize that there are only twenty universities in the German Empire, it is obvious that in America we have an oversupply, and a further reduction, in the light of modern educational demands, is inevitable. Already the large majority of low-grade colleges are not fully recognized by some twenty-four state licensing boards.

Stupendous improvements have been made. The four-year course is universal. A four-year high-school course is the minimum requirement for entrance. All of the better colleges have adopted in addition a premedical year of chemistry, physics, biology and a modern language, which goes into effect in January, 1914. Thirty-two medical colleges require as a minimum for entrance two or more years of college work in addition to the four-year high-school course. There will not be an increased college requirement, because that would keep the man too long and he should not be over 24 or 25 years of age when he begins his life work.

The next and much-needed advance is the compulsory or fifth year spent as a hospital intern. The council on education is now preparing data for this work. While the council has, of course, no legal function, still, if it can do the investigative and standardizing work for the hospitals in this country that it did for the medical colleges, it will do great good. In connection with the Council, the Carnegie Foundation for the Advancement of Learning signified its willingness to help. A munificent endowment has been set aside for this work.

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It will consist of an intensive investigation of the hospitals in the thirty-five most populous centers, together with the inspection of all the hospitals in this country. They will be classified somewhat similarly to the colleges. The basis of classification being the number of beds, the amount of endowment or appropriation for their support, the equipment and laboratory facilities, the methods of organization and willingness to furnish proper training for medical students. At present there are a total of about 3,000 interns. The combined graduating classes equal about 4,500 students. This still leaves about 1,500 graduates for whom hospital internships should be provided if the internship year becomes compulsory. As about 1,400 hospitals, having approximately 3,500 beds, have no interns, it seems that this matter could be easily arranged. I have referred to this matter only from the intern's standpoint, but it is apparent that the good accruing to the hospitals themselves, the general uplift from more detailed information as to their needs, and a constructive policy for betterment are benefits almost incomparable.

Even now over one-half of the high-grade colleges placed 70 per cent. of their graduates in hospital positions last year. Some such arrangement as withholding a license to practice until after the hospital year has been satisfactorily completed would be very desirable. Let final examinations occur at the end of the fourth year, but licensure should not be completed until the hospital service is finished.

Every hospital should require the most promising of the interns to continue their service into the second or third year as house surgeons. This not only gives the capable man longer training, but also is a protection when the house staff changes; it is a great help to the new interns; a stimulus to their best efforts and the only way to keep up the traditions, methods and *esprit de corps*. Whenever possible the large hospitals should inaugurate the system of having a resident surgeon,

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choosing the exceptional man, whose tenure should be indeterminate. This increased opportunity for surgical training and the prolonged inspiration of his chief would afford the best of facilities for a great surgical career.

Quoting again from Halstead:

> It is a grave mistake, it is a shame, to check suddenly the advance of these superior young men, who are tense with enthusiasm, who rejoice in the work to which they hope to be able to dedicate their lives. It is from these men, we must not forget, that our teachers of surgery are made.

The foundation in Washington last month of the American College of Surgeons, which has for its purpose the elevation and standardization of surgery for the benefit of the profession and the protection of the people by the granting of a fellowship to all men whose surgeonship is established and the conferring of the title F. A. C. S., which will indicate to the public and the profession that its possessor is well qualified to practice this branch of the profession as a specialty, seems to give form to the movement for increased requirements and the maintenance of a higher standard. The college is to be independent of all societies, continental in scope, democratic in spirit and eventually to comprise all of the men in the United States and Canada who are properly qualified and so to designate them.

It is to be presided over by a board of governors, elected by the college. A board of regents, chosen by the governors, acting as trustees, will from time to time establish requirements for the granting of fellowships. All surgeons of prominence having had five years in the practice of surgery, or one of its specialties, who are of unquestioned moral character, measured by the standard of the college, and who are vouched for by the committee on credentials, are eligible to fellowship without examination.

Ultimately, the college will formulate prescribed requirements, with examination, for the younger men

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who are candidates for the fellowship. Already the founders represent every large city in America; all of the medical universities; all of the general and special surgical societies; all of the important hospitals and clinics, and a large number of independent surgeons throughout the continent.

It seems that this movement is of transcendent importance. If all of the good men who are properly qualified become Fellows of the American College of Surgeons, and those who morally and educationally are unfit to do surgery are not accepted, it will be a crystallization of the high ideals for which the American Medical Association has always stood.

Every man who expects to practice surgery as a specialty should be required to act as chief assistant to a master surgeon for at least three years, and better five. It will be objected that this is too long, but the goal is not for those who soon weary of study and protracted preparation. Apprenticeship is far more essential in surgery than in any of the arts in which it is universal. A man is obliged to act as apprentice a specified number of years before he is allowed to pilot a lumber scow. Who asks to see the pilot's license when a surgeon is needed to pilot the frail bark of life through the treacherous "waters that separate the island of Time from the mainland of Eternity"?

We need a system of requirements and a course of training, and they surely will be realized, that will make of the first youths of our land what their abilities and ambitions entitle them to be, will attract to surgery the very best material and will make of the rank and file well-equipped and conscientious surgeons.

As suggestive the following outline of requirements is formulated:

1. A full four-year medical course in a high-grade medical college or university, leading to the degree of M.D., after adequate high-school and the special one-year premedical science course in college. It is especially desirable that, in addition to thorough fundamental and laboratory training in anatomy,

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physiology, pathology and bacteriology, such schools provide ample, practical instruction in dispensary and ward classes in medicine, surgery and the specialties, with practical midwifery and post-mortem work.

2. Compulsory hospital internship in a good general hospital, with adequate laboratory facilities, for at least one year and if possible two years.

3. Certain high-grade colleges maintaining or controlling exceptionally good hospitals should be encouraged to give a one-year graduate course in surgery after two or more years' hospital work, or after three to five years of general practice leading to the degree of master of surgery, which in addition to practical hospital work should thoroughly teach gross pathology, operative surgery on the cadaver, perfected technical work on the viscera of slaughtered animals, and experimental surgery on the lower animals. The student should be brought into close touch with the research laboratory. This would fill a great want. So many well-prepared and ambitious young men after being in practice for several years and doing some surgery with more or less success, are anxious and clamorous to take additional work, to which they are willing to give the required time and for which they are willing to pay. They importune many individual surgeons to take them as private assistants. The strictly postgraduate schools have been of considerable value to such men, but as a rule the courses are not long enough.

4. In addition to a compulsory hospital internship before licensure, a specified number of years of general practice, or extra years in a hospital, should be required of those who would make surgery a specialty. No man can become a good surgeon without the illuminating experience of general practice.

5. Before taking up surgery, a man should be required to serve at least three years as assistant to an established surgeon.

6. The requirements need not be quite so exacting for the aural or ophthalmic surgeon, but should embrace as a minimum at least two years' hospital work, one year in general and one year in special work, the latter to follow at least two or three years in general practice.

7. It would seem desirable that a prescribed course of study and training somewhat in conformity with the foregoing should be followed by examination and conferring of a distinctive title to distinguish the surgeon from the internist.

8. The establishment of certain legal requirements for the practice of surgery, to be enacted into a uniform state law, or if possible into federal law, providing for special examination and licensure. Such a law was introduced into the Illinois legislature at its last session and embodied most of the suggestions herein set forth.

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In the making and maintaining of a high degree of surgeonship, the value of travel and studying the work of the great clinicians of our country, as well as those of Europe, cannot be too forcefully urged. Kocher has been the traveler of Europe, and the men who have the greatest clinics of America are themselves the greatest observers of the work of others.

The obligation of the profession in medicine, as well as in surgery, is a very sacred one. It must be our constant endeavor, by the unwritten laws of custom, by the force of speech, by ethical regulation in the profession, by educational betterment and by statutory enactment, to safeguard the traditions and ideals of the profession and fulfil our highest obligation in caring for the lives, the health and the happiness of the people of this country.

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INJECTION OF BOILING WATER IN THE TREATMENT OF HYPERTHYROIDISM

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Accepting the theory that the symptom-complex shown in exophthalmic goiter was best explained by an hyperactivity of the thyroid-gland cells and having had some very satisfactory experiences in the treatment of angiomas by the injection of boiling water as first advised by Dr. John Wyeth of New York, it occurred to me that the injection of boiling water into the hyperactive thyroid gland might prove a safe and efficient remedy in exophthalmic goiter.

I first suggested the treatment at the St. Louis meeting of the Southern Surgical Association in December, 1908. In 1909 experiments were made for me on three dogs by Drs. C. G. Beall and H. K. Mouser. These experiments seemed to show that the treatment was safe and that the injections of boiling water would destroy both normal and goitrous gland tissue.

On this basis I commenced the treatment. Up to date the treatment has been used chiefly in three classes of cases:

1. Those in which the patients were too sick to make safe surgical risks. To this class should be added cases of diving or substernal goiter, the removal of which would be extra hazardous.

2. Those in which the patients presented mild symptoms.

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3. Those in which the patients refused major surgical procedures. In this third class was one patient who had had a partial thyroidectomy.

Up to the present writing I have treated over twenty patients, representing in all over one hundred injections. The quantity injected at each point varied from 40 to 230 minims. From one to three injections were given at each treatment. The largest quantity injected at one treatment was 660 minims, equally divided between the isthmus and the right and left lobes. The greatest number of injections given any one patient was eleven.

In addition to this clinical study, I had further experiments made on the dog by Dr. Gatch of the Indiana University School of Medicine, and, in our own laboratory and that of Dr. B. W. Rhamy, I have had sections of human thyroids studied immediately and some weeks after injecting them with boiling water. The laboratory and clinical studies above referred to form the basis of this paper and will be published with it.

The injection of boiling water into the thyroid gland is a safe procedure. This statement is based on the more than one hundred injections (varying in size from 40 to 230 minims each) that I have given myself and on the further fact that I have learned of no untoward effects from others who I know have tried the treatment and who were requested to report to me.

On one occasion I injected by mistake hot air or steam. On another occasion it was noted that the few drops of water left in the syringe were colored with blood and a hematoma followed this injection but caused no trouble (see Case 12).

The immediate effect of the injection is destruction of thyroid tissue and colloid. A further destruction of thyroid cells occurs as a result of the formation of fibrous tissue consequent on the injection. (See Figures 1, 2, 3, 4, 5 and 6 and the reports of Gatch, Edlavitch, Rhamy and Beall.)

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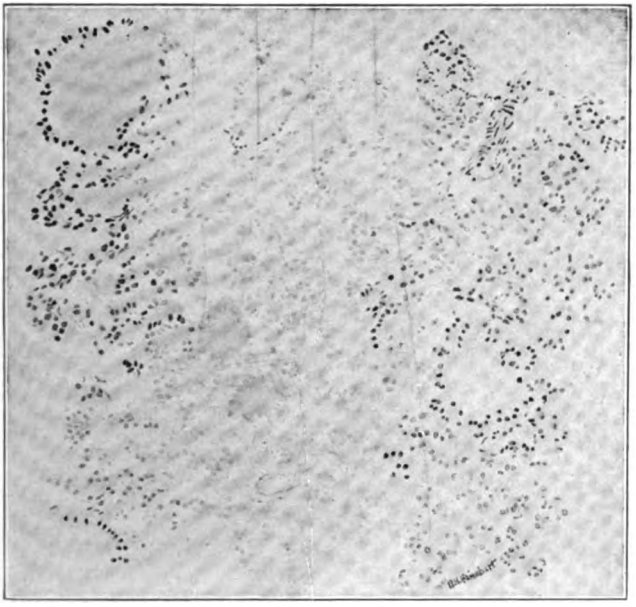

Fig. 1 (Dog No. 1).—Section of thyroid removed immediately after hot water injection, showing extensive destruction of the thyroid tissue. In places the epithelial cells are entirely destroyed, leaving nothing but a connective-tissue network. The colloid has been in large part dissolved and where not completely dissolved, it has been so altered that it no longer takes the eosin stain well. This figure and Figures 2 and 3 were drawn with camera lucida, Leitz obj. 6, oc. 3.

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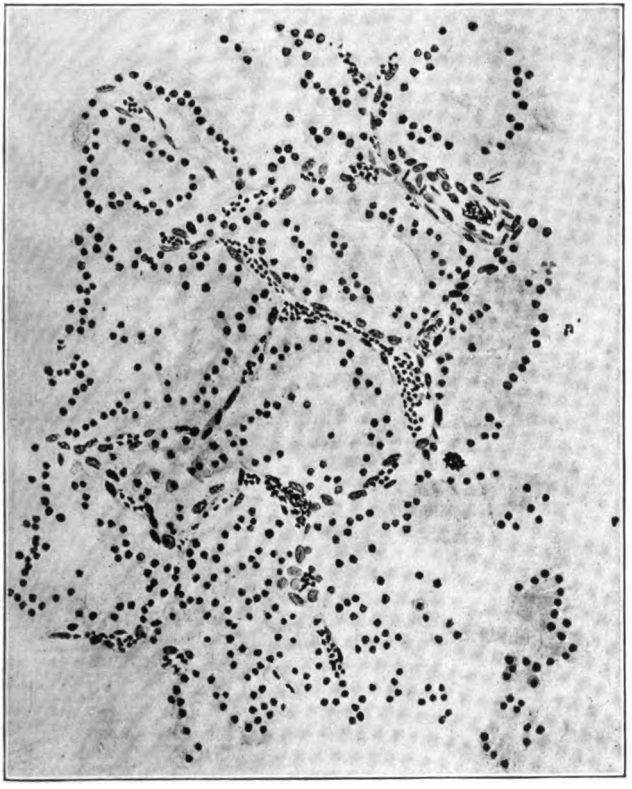

Fig. 2.—Dog's thyroid. Section made from point somewhat removed from site of injection, showing absence of colloid and a separation of the cells from the basement membrane.

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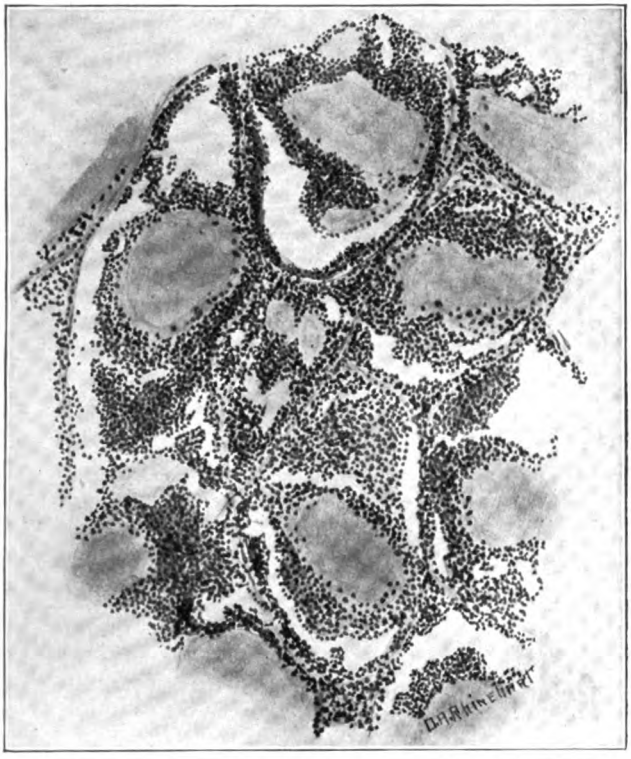

Fig. 3.—Dog's thyroid. Section made at point of injection showing complete destruction of gland-cells, partial destruction of colloid with filling of acini with red blood-cells.

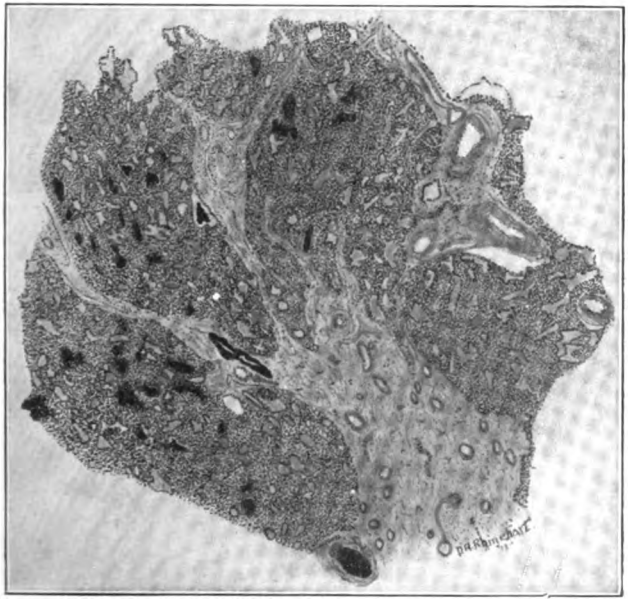

Fig. 4 (Dog 3).—Killed eight weeks after injection of thyroid with hot water. Gland removed and sectioned. Note the great amount of fibrosis and small amount of colloid.

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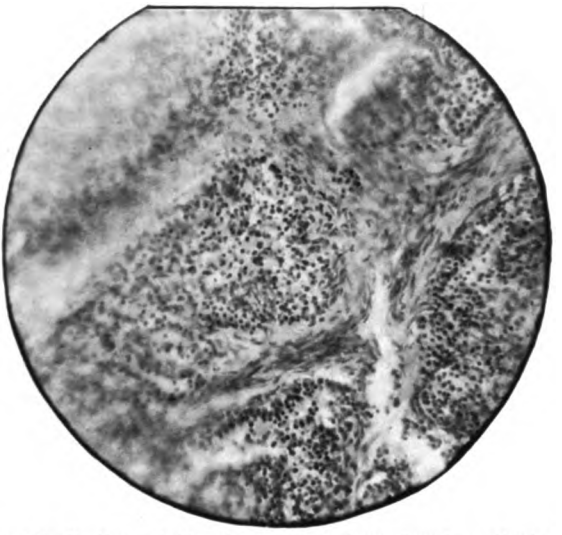

Fig. 5.—Section of thyroid removed from female patient after treatment by injections of hot water. Sections made four months after last injection and ten months after first. The prevailing picture is one of connective tissue hyperplasia. Note the thick strands of cicatricial connective tissue constricting and compressing the parenchyma, thereby completely obliterating the gland structure. ×265. (B. W. Rhamy.)

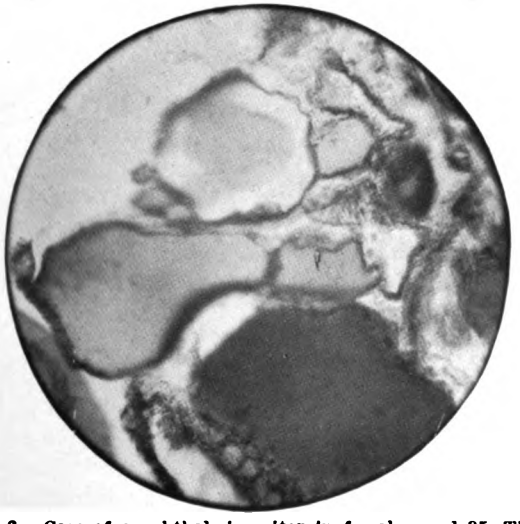

Fig. 6.—Case of exophthalmic goiter in female, aged 35. Thyroid was removed, and soon thereafter the gland was injected with about 200 minims of boiling water. Microscopic examination of the part thus treated shows some necrosis of the epithelium here and there, with absence of the colloid substance in some of the alveoli and loss of its staining characteristics in others. Many of the alveoli are distended, and the interstitial connective tissue is slightly edematous. (B. M. Edlavitch.)

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These laboratory findings are corroborated by the clinical observation that both the symptoms and the size of the gland continue to decrease, as a rule, for some days after the injections are given.

With the aid of local anesthesia in the skin at the point of puncture, there is no pain from the puncture or the heat. The discomfort produced by the treatment is usually negligible and consists of a feeling of distention in the gland and pain running up the back of the neck to the occiput on the side of the injection. On two or three occasions this pain in the head was quite severe. Usually it passes away in a few minutes, but in one case (Case 4) it was thought well to give a dose of phenacetin and caffein after one of the treatments, though there was no unusual pain following later injections. In Case 2 there was an unusual complaint of pain "all over the head," but it subsided in a few minutes. Of the twenty-two patients herewith reported one (Case 13) had carcinoma and was injected to check the hemorrhagic discharge and with the hope that the growth might be checked somewhat. One patient (Case 14) was given one injection of 100 minims without benefit and it was subsequently determined by her physician that her symptoms were not the result of hyperthyroidism. This leaves us with twenty cases of hyperthyroidism treated by this method to the exclusion of all other treatment, save that in three cases rest in bed was continued for a time, the patients being unable to be up when the treatment was begun.

Of these twenty cases in one case the result, after one injection, is unknown. In one (Case 19) the symptoms are improved, but there is no change in the size of the goiter. This patient is still under treatment. Thirteen patients were so much improved as to be able to perform their ordinary duties, and are now doing so well that they consider further treatment unnecessary. One patient had the right lobe injected three years after removal of the left, for headache and pain in stom-

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ach. She now considers herself well and there has been no further enlargement. In one patient (Case 22, a patient of Dr. Duemlings) the pulse was so rapid, weak and intermittent as to make an accurate count almost impossible. One injection reduced the pulse to 84 per minute with a marked improvement in the general condition and the patient left the hospital without further treatment.

Four patients were cured. This term is used relatively. As nearly as is possible to do so, only those patients have been pronounced cured who show no signs of continued hyperactivity of the thyroid. In Case 6, for instance, the heart and eyes of the patient were permanently damaged before treatment was begun. With the injections this patient regained her normal weight, the menses returned after they had been absent for six months and she slept and ate well. Now a thyroidectomy was done for cosmetic purposes. The additional improvement after the thyroidectomy was slight.

One of the patients designated as cured (Case 20) had a miscarriage during the writing of this paper. It is possible if not probable that this miscarriage indicates some hyperthyroidism still present and another injection might be of benefit, though the patient considers herself well. It should be added that the mental symptoms in this case were very prominent, amounting to a mild insanity.

Of the cases which resulted in cure one was of the extremely severe type, one severe, and two were moderately severe as judged from the physical signs. Time will not permit a complete analysis of all the cases reported here, but I wish to say that I have been careful, and that if any error has been made, it is on the side of conservatism. In a former paper reference was made to the fact that the injections produced adhesions of the capsule to surrounding structures, and that these adhesions might interfere in case thyroidectomy were done later. Fur-

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ther experience has shown that there will be little or no trouble from this source if the injections are made with a small needle and well into the center of the gland.

On several occasions it was noted that during a treatment, that is to say, for instance, after the first injection in a case in which three were given at a treatment, the pulse would drop markedly before the completion of the treatment. One would expect a nervous patient to show a rise in the number of pulse-beats in anticipation of the treatment and a similar fall after the treatment was finished, but a decided fall in the pulse-rate during the treatment struck me as an interesting fact, and it is recorded merely as such without any attempt at explanation.

It has been noted that some injections seem much more effectual than others of equal size and temperature. This is interpreted to mean that in some cases the hot water gets into parts of the thyroid that are very active and in some into parts relatively inactive.

TECHNIC

No special syringe has been devised for the treatment. I have found a large all-glass graduated syringe the most convenient. In my first cases I used ordinary antitoxin syringes. The glass barrel prevents one from injecting air, and the more water the syringe holds the less rapidly it loses heat when filled. Having the plunger and barrel of the syringe both made of glass prevents binding or breaking from unequal expansion, both of which annoyances are apt to occur when barrel and plunger are made of different materials. It is better to have the needle long and rather fine. I boil the syringe by the side of the patient in the water to be used for injection and keep the water boiling until the treatment is finished. The heat is furnished either by an alcohol lamp or a Bunsen burner. When more than one injection is given at a treatment, the syringe is reboiled after each injection to insure having the water

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enter the gland as near the boiling point as is possible. The syringe is handled with the aid of a long pair of forceps, the points of which are also heated, and a piece of sterile gauze or muslin.

The skin, after being cleansed, is anesthetized with Schleich's solution by producing a small wheal at the points where the needle is to be inserted.

Care is taken to avoid the large superficial veins and the injection should be deposited inside the capsule. With a long needle different areas may be injected through the same skin puncture by partly withdrawing the needle. In this way both right and left lobes and the isthmus may be injected through one skin puncture made in the center of the neck. The needle is first thrust well into one lobe and the water thrown in, then the needle is partly withdrawn and the proximal part of the same lobe and isthmus injected, now the needle is withdrawn from the capsule but not from the skin and inserted into the opposite side of the gland, which is injected as was the first.

Frequently it may be better to make separate skin punctures for each injection. The position of the point of the needle should be changed only by withdrawing it partially and by withdrawing and reinserting it in the direction desired. To change the location of the needle point by swinging it through the substance of the gland might give rise to troublesome hemorrhage.

After the treatment is finished the needle punctures are covered with gauze wet in alcohol for a few minutes. This is all the dressing needed. The needle punctures leave no noticeable scars if one is careful not to let the needle lie on the skin. My patients have been requested to remain lying down for a half hour or an hour after each treatment, but some have arisen and left the hospital within fifteen minutes with no untoward results.

There can be no serious objection to making a small incision down to the capsule and inserting the needle

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under guidance of the eye. This would perhaps be the procedure of choice in very small and certainly in diving goiters. This method has been used in dogs but not as yet in the human subject, though I mean to use it in the first case in which it seems wise to do so.

The immediate effect of the injection is to increase the size and density of the goiter. There is also a temporary rise in the temperature of the gland which can be appreciated by the hand when a moderately large quantity is injected. Later on the gland diminishes in size and in some cases becomes unappreciable. The improvement in symptoms is prompt, being marked usually within twenty-four hours after the treatment. It has been noted, however, that the improvement continues to progress for a week or two weeks. This is thought to be due to the fact that the connective tissue, which is caused by the injection, puts gland-cells not immediately affected by the hot water out of commission by incorporation and compression (Figs. 4 and 5).

On the basis of these observations, it is thought better to allow an interval of at least a week to intervene between the treatments to avoid too great destruction of the gland.

My observation in about twenty cases, in which this point was carefully noted, leads me to believe that the injections always cause a decrease in the size of the gland. However, the treatment has never been given for this purpose alone. Quite frequently after partial thyroidectomy the remaining portion of the gland enlarges with or without symptoms of hyperthyroidism. In such cases I think the injection of hot water will prove of service. Case 3 is one in point.

The facts seem to warrant the conclusions that the injection of boiling water into the thyroid is a safe and efficient method of treating hyperthyroidism and that it will prove of especial value in those cases wherein either the location of the gland or the severity of the symptoms

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precludes the operation of thyroidectomy, which operation, it is well to add, remains the treatment of choice in patients who are good surgical risks.

REPORTS OF CASES

CASE 1.—Miss H., aged 46, single, seamstress. Small goiter involving isthmus of thyroid the size of a large hickory nut, first noticed fifteen months ago. Rapid heart and tremor for about a year. Lost 10 pounds. No exophthalmos. Tremor still marked but not severe. Weight 113 pounds. Pulse 116. Sept. 12, 1912, 150 minims given. Sept. 20, 1912, goiter diminished in size, decidedly softer. Sept. 27, 1912, pulse before injection 110, after injection 106; 165 minims injected. Oct. 15, 1912, 450 minims injected into isthmus and right lobe. Pulse 88 after injection. Nov. 11, 1912, weight 118¾ pounds (a gain of 5¾ pounds). Goiter has practically disappeared; tremor absent in left hand, noticeable in right. Pulse after coming up stairs 116, regular and of good volume. Jan. 28, 1913, physician says she is no better. Goiter smaller but hyperthyroidism as bad as ever. Pulse 140 to 160.

CASE 2.—Mrs. A. H. J., aged 49. Maternal aunt and two cousins have goiters. Menopause nine months ago. Has daughter with goiter. First noticed large neck when 19 years old. Neck has not grown much larger. Dyspnea on exertion. Frequent colds and headaches. Electrical treatment for neck without benefit. Weight 135½. Enlarged thyroid involving both lobes and isthmus with supernumerary lobe on left, firm and even. No eye signs. Tremor present. May 27, 1912, 140 minims injected into isthmus, 170 in right lobe. Complains extraordinarily of that region and all over head. Subsequent history not at hand.

CASE 3.—Mrs. F. S., aged 34. Left lobe of thyroid removed three years ago. Complains of frequent headaches and pain in the stomach. No tremor, no nervousness, no tachycardia. Right lobe of thyroid size of a large almond with shell on. June 26, 1912, 170 minims injected into right lobe. Pulse at time of injection 84. Feb. 8, 1913, feels well; no further enlargement of right lobe. Neck was sore and stiff behind the sternomastoid for a week after the injection.

CASE 4.—Miss L. S., aged 22, seamstress. Maternal aunt had goiter. Always nervous girl. Lowered strength and vitality for two years. One and one-half year ago complained of feeling tired and having distress in region of heart. Six months ago noticed prominence of right eye and tremor of hands. Swelling of legs and ankles at times. Weight 116. Pulse 140, small volume. Exophthalmos of right eye. Edema of legs. Tremor of both hands. Diffuse goiter rather low.

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May 10, 1912, 150 minims into right lobe. Pain in back of head and neck and in back of ear at site of injection. Very nervous. May 23, 1912, 200 minims in left lobe, 120 in right. Exophthalmos better. Injections did not cause much distress. June 13, 1912, 180 minims in right lobe, perhaps on top of capsule. Eyes protruding a great deal. Left lobe of thyroid swollen. Right lobe not so marked. Very nervous. Right side of neck tender at point of former injection. Pulse 128 after injection. June 28, 1912, weight 128 pounds (a gain of 12 pounds); exophthalmos much better. Pulse 132, stronger and more regular. Injection of 180 minims made into right lobe at isthmus. Went to the Pacific Coast on a visit and has not been heard from since.

CASE 5.—Mrs. E. R. V. D., aged 41. Heart fluttering for four years. Tremor for eighteen months. Dyspnea on exertion. After three weeks in bed much better. No tremor, but there had been previously. Right lobe of the thyroid enlarged to the size of a hulled walnut. No eye symptoms. Weight 135½ pounds. Slight edema of legs. Marked cardiac arhythmia with enlargement. May 5, 1912, 60 minims injected May 17, pulse very arhythmic, about 60; 120 minims injected with considerable pain. May 29, 1912, 50 minims in region of isthmus. Goiter entirely disappeared except slight enlargement of isthmus, possibly due to thickening of tissue covering gland. Subsequent history not at hand. Physician does not know about her present condition. Letter Feb. 9, 1913, says "derived a great deal of benefit."

CASE 6.—Miss J. H., aged 26, weight 86 pounds. Excessive tachycardia and tremor. Pulse 140 to 150. Condition too poor for operation. July 30, 1910, two injections, 120 and 125 minims, into right and left lobes. Aug. 5, 1910, three injections, 80, 100 and 120 minims. First two in right lobe, third in left. August 17, three injections, 90, 120 and 160 minims. First two in left, third in right. Injections September 8, September 27 and October 20, the exact amounts not known. December 8, two injections, 100 and 120 minims, in the right side. March 2, 128 minims injected. March 9, 90 minims injected. Patient gradually improved; blood-pressure dropped from 180 to 150. Pulse dropped from 140 and 150 to 90 and 100. Weight increased to 145 pounds, and she seemed in good enough condition to warrant operation. Operation was performed May 16, 1911. During the convalescence patient suffered a hemiplegia, apparently due to hemorrhage dependent on arterial degeneration attendant on the toxemia from the hyperactive thyroid. Patient recovered, however, and is now in comparatively good health; weight over 130 pounds. Exophthalmos slight; patient somewhat nervous, but otherwise well. The heart, of course, remains considerably damaged.[1]

1. This case was reported in detail in THE JOURNAL A. M. A., Sept. 11, 1911, p. 1120.

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CASE 7.—Mr. J. M., aged 32, nervous, had pain in occiput and insomnia; thyroid gland enlarged for last twelve or fourteen years. Heart slightly enlarged, otherwise normal. Two injections, 5 c.c. each, in July, 1910, into isthmus and right lobe, this being one of the very first injections made on the human being. After-effects slight; consisted of a bulging sensation lasting for a few weeks. Patient thinks there was slight benefit derived. Examination later by Dr. Mayo. Patient was advised against operation, doctor thinking the gland was doing no harm.

CASE 8.—Miss E. H., Kendallville, Ind., aged 25. Tachycardia, nervousness, loss in weight; pulse 100. Thyroid distinctly enlarged. Injection of 40 minims into each of two lobes. Seemed benefited for two months, during which time her pulse ran from 68 to 80. Injection April 18, 1910. No further injections. Owing perhaps to a change in patient's address, I failed to get a late report.

CASE 9.—Mrs. S. Y., aged 41. Nervousness, tachycardia, thyroid hickory-nut size. Nov. 29, 1911, 100 minims injected into right lobe. Dec. 22, 40 minims injected into right lobe, which was reduced in size. Pulse 96. Jan. 4, 1912, very small nodule remains. No injections. Jan. 20, 1912, pulse 94 after walking up stairs. April 17, 1912, 30 minims injected. Pulse 80 before and afterward. Very much improved in every way. Now on trip to Europe. Salvarsan injection April 18, 1912; no serious after-effects.

CASE 10.—Mrs. R. S. Blood-pressure 160 to 140. Pulse 120. Injections of 45 minims into isthmus. Later note says that she has improved in every way, with increase in weight. No details given.

CASE 11.—Mrs. J. S., aged 45. Complaint, weakness, tired feeling, tachycardia, dyspnea on exertion, "nervous spells" "apparently beginning" in stomach and then going all over her with nausea, extreme nervousness and weakness. Pulse 100 to 110. Injection of 50 minims into the right lobe in two places. Pulse afterward 72 to 85. April 29, 1912, feeling fine. Pulse 80. Thyroid smaller. July 30, 1912, pulse 75 to 100 after a walk to the hospital. Jan. 2, 1913, patient says she has been markedly benefited but is still troubled at times.

CASE 12.—Mrs. G., aged 55. Complaint, tachycardia and nervousness. Nov. 29, 1911, 60 minims injected into right, 60 minims into left lobe. First injection hot air. Dec. 6, 1912, 120 minims injected into right in two places, 60 minims into left. December 22, four injections, each of 55 minims. One of the two injections in left followed by hematoma and fluid in syringe colored; two injections in right lobe, first possibly on top of capsule. Pulse 130 to 110 before injections. Dec. 31, 1912, patient considered herself cured.

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CASE 13.—Mrs. H. Rapidly enlarging goiter. Section removed and pronounced by pathologist carcinoma. Neck reduced in size and drainage much less under x-ray treatment. July 20, 1912, injection at three points of 200 minims. Neck 15 inches in circumference. July 30, 1912, 160 minims injected middle, 160 minims right. Neck measures 14 and 11/16 inches. Weight 160½ pounds. Patient was choked to death by increase in size of gland five months after last treatment and ten months after onset of carcinoma.

CASE 14.—Miss W., seamstress, aged 30. Complaint, nervousness, weakness and tired feeling. Moderate tachycardia. Two injections July 3, 1912, 90 minims in right lobe; July 6, 100 minims into right lobe without benefit. January, 1913, still has same symptoms as before. Thyroid in this case very slightly enlarged, scarcely more than palpable right lobe.

CASE 15.—Mrs. W., aged 55, in the hospital with a pulse of 180, arhythmic, bruits, etc. Markedly enlarged thyroid of fifteen years' duration; many severe attacks with intermissions. Edema to waist. Complete orthopnea for three months. With rest in bed edema disappeared and heart quieted a little. Oct. 18, 1912, 210 minims injected in each of two points in large lobe. Oct. 25, 1912, 230 minims injected into right lobe above, 180 minims lower down. Neck was smaller, heart more regular, somewhat slower; edema entirely gone. Patient is now fairly comfortable. She has not yet returned for further injections.

CASE 16.—Miss W., librarian. Symptoms, tremor, tachycardia, nervousness, slightly enlarged thyroid. One injection given. Patient symptomless ever since, now over a year. There was amenorrhea in this case for three months. Patient now menstruates regularly.

CASE 17.—Mrs. K. Nervous all her life. Some tachycardia. Pulse ranging near 100. Thyroid larger fifteen years ago than at present. Some pain in chest. No exophthalmos. Feb. 26, 1912, 60 minims injected through two punctures. Jan. 16, 1913, much less nervous since injection, less palpitation and tachycardia; not altogether free, however. Operation done about the same time for salpingitis. Has gained 12 pounds in weight.

CASE 18.—J. W. K., aged 52, farmer, fairly well until last three months, when he commenced to feel weak, short of breath and very nervous; has had severe pain in left shoulder, lost weight, had goiter for twenty years; pulse 122, marked tremor, no eye signs. Right lobe size of hen's egg; isthmus size of hulled walnut. Isthmus more firm than right lobe. Boiling water injected, 230 minims at each point, Nov. 25, 1912. Dec. 26, 1912, two injections principally into isthmus and right lobe, 230 minims each. Dec. 24, 1912, 220 minims

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injected into right lobe, 220 minims into isthmus, similar injection into left lobe. Subsequent history not obtained. Feb. 12, 1913, patient says he is "getting along fine" and thinks he may not need any more treatment.

CASE 19.—Mrs. J. W. D. Swelling in neck for twenty-five years. Past year has noticed palpitation of the heart; has had no flushes or nervous manifestations; has large asymmetrical swelling extending from wall through on neck 21 cm. wide and 9 cm. long; no exophthalmos; pulse 96. Nov. 26, 1912, 120 minims boiling water injected, 60 minims on each side. Dec. 6, 1912, 250 minims injected into right lobe and 250 minims into isthmus. Dec. 11, 1912, neck measures 15¾ inches, pulse, sitting, 78. Patient thinks heart is better.

CASE 20.—Mrs. C. W. (Dr. Beall) complains of nervousness, tachycardia, slight exophthalmos, some dyspnea, of three months' duration. Menstruation not disturbed. Patient has had noticeable goiter for years. Injection June 24, 1912, 120 minims into right lobe. Pulse 98. July 24, 1912, 120 minims injected into right lobe. Marked improvement; patient comfortable ever since.

CASE 21.—Mrs. X., (Dr. Beall) first seen in October. Tachycardia, pleurisy and negative tuberculin reaction. Thyroid began to enlarge in November. January 7, 150 minims injected into right lobe, 35 minims into isthmus. Some improvement. Patient can now do some work though she was incapacitated before in spite of rest, bromids, digitalis, ice to the neck, etc.

CASE 22.—Mrs. X. (Dr. Duemling) has very large goiter, marked myocardial degeneration, severe arhythmia and tachycardia. She is adjudged too sick for operation after forty-one days' routine treatment in bed. Following the injection of 20 c.c. of hot water the pulse dropped to 84. General condition seemed markedly improved. The improvement continued for a week, when the patient left the hospital without further treatment.

PROTOCOLS OF EXPERIMENTS

DOG 1 (Dr. W. D. Gatch).—Operation Feb. 15, 1913; subject, a very large, slate-colored dog of the mongrel type. Under ether anesthesia both lobes of the thyroid were exposed through a mid-line incision in the neck. Several cubic centimeters of hot water were injected into each lobe, the needle being accurately inserted into the middle of the gland. The gland, following the injection, at first became blanched, but soon changed to dark blue color from the formation of a hematoma. It swelled to two or three times its normal size. The wound was carefully closed and healed by first intention. The dog, following this experiment, has shown no change in its general condition. It appears normal in every way.

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Dog 2 (Dr. Gatch).—Operated on Feb. 15, 1913. Subject was a small red mongrel dog. The operation was the same as in Dog 1, and the changes following the injections of hot water were the same. In this dog, however, half of the right lobe was excised, and placed immediately in 10 per cent. dilution of liquor formaldehydi. The hot water exuded from the cut surface of this lobe. On section the excised piece of tissue had the appearance of a piece of meat dipped in hot water. Healing was by first intention.

Feb. 27, 1913: The dog was found dead this morning. It had been somewhat torpid, and had not taken food well since the operation. It had shown, however, no very definite symptoms.

Necropsy: The right lobe of the thyroid measured about 1.5 by 0.5 by 0.5 cm. This was about half or less than half its normal size. It was slightly adherent to the surrounding structures but was easily removed entire. Its gross appearance was that of a lymph-node. On section it was found to be of a pale, whitish color. Only a few small pieces of the right lobe of the thyroid could be found. The dog was somewhat emaciated but the necropsy showed all organs with the exception of the thyroid to be normal.

A normal section (from a piece of thyroid excised at operation) shows extensive destruction of the thyroid tissue, in places the epithelial cells being entirely destroyed, nothing but a connective-tissue network remaining. The colloid material has been in large part dissolved and where not completely dissolved, has been altered so that it no longer takes the eosin stain.

A second section (from a lobe obtained at necropsy) shows, I think, a remarkable picture. The colloid here is almost entirely gone with the exception of one small area where the colloid is preserved, but the cells are entirely necrotic. The pieces of glandular tissue have been entirely replaced by fresh connective tissue and in spots where the epithelial cells remain they show extensive degeneration and detachment from the basement membrane. The alveoli do not contain colloid.

It is possible, of course, and I think quite probable, that the thyroid cells left intact after injection might hypertrophy and supply the demand for thyroid secretion. This is probably what happened in the first dog. The adhesions following the injections were slight and no more extensive than you would expect from dissecting the gland out of its bed and then replacing it. Care was taken, however, to get the hot water inside the capsule.

Dog 3 (Dr. Gatch).—Killed eight weeks after injection of thyroid with hot water. Gland removed and sectioned. Sections of thyroid are especially interesting on account of the

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great amount of fibrosis and very small amount of colloid substance. (Fig. 4).

Dog 4 (Drs. C. G. Beall and H. K. Mouser).—Weight about 25 pounds. Forty minims of hot water were injected under ether anesthesia. No change in dog's clinical condition. Three weeks later, by same method, 60 minims were injected into the left lobe. No change except that the dog became somewhat thinner. Dog disappeared.

Dog 5 (Drs. Beall and Mouser).—Right lobe injected with 40 minims. In two weeks a second injection was given. The dog died from overetherization. The thyroid was removed and examined microscopically by Dr. Beall. The examination shows that the gland tissue at the site of the injection has disappeared, being replaced by connective tissue.

Dog 6 (Drs. Beall and Mouser).—About three months old, rather small, with a marked goiter. Both lobes injected (spring of 1909). Goiter disappeared almost entirely. The dog was still living and remained free from goiter at the end of four years.

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NEPHRITIS

ITS TREATMENT WITH THYROID AS A PRELIMINARY TO OPERATION

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Last year I published[1] my experiences with large doses of desiccated thyroid gland in the treatment of the usual form of nephritis. I now record my further experience with this agent, and urge its use in the treatment of nephritis as a preliminary to surgical treatment which may be necessary in such cases.

It is unnecessary, I am sure, to insist that the thyroid gland, even if given in large doses to those suffering from nephritis, will not remove the symptoms in the cases in which the disease is secondary to advanced heart or liver changes. This can also be said to be true when the symptoms of the nephritis are due to infections of the genito-urinary tract, especially tuberculosis, nephrolithiasis, an ascending infection due to an infected bladder coincident to an obstructing prostate gland, or a surgical kidney. These are also without the pale of favorable consideration of this treatment. It is difficult to state, at this writing, where the destructive limits of nephritis cease to be favorably influenced by the thyroid treatment. With an increasing number of personal observations, and reports from the profession giving their experience in a large number of cases, its place should be determined within a reasonable time. It requires no stretch of the imagination to recognize, however, that this treatment will not overcome the symp-

1. Percy, J. F.: Thyroid Extract in Nephritis, THE JOURNAL A. M. A., Nov. 9, 1912, p. 1708.

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toms incident to a comparatively complete disorganization of the tissues of both kidneys. On the other hand, I believe that I shall be able to show in subsequent reports that the thyroid gland, when given even in the last stages of true nephritis, as a clinical fact does divert the metabolic processes of nutrition, especially with reference to proteins, to a degree sufficient to compensate, for a length of time not yet determined, for the failure of the physiologic function of the kidney.

I have not had a sufficient number of cases to determine the value, if any, of the thyroid-gland treatment when nephritis exists as a complication of diabetes mellitus. But I believe, from the results so far obtained in three cases of this not infrequent complication of nephritis, that it is worthy of more than a mere trial.

Fortunately, or unfortunately, the majority of the cases of nephritis which I have treated, especially since the publication of my former paper, have been advanced cases. My conception of this disease in the average case is as follows: Cardiovascular changes with a blood-pressure above 150 mm. of mercury. The average blood-pressure can be placed at 200 mm. of mercury. With this, there are present albuminuria and degenerative casts, coarse and fine granular, blood, fatty, hyaline and waxy. The albumin frequently is found to represent 7 gm. to the liter.[2] In one case, that of a physician, the amount was 14 gm. This urine would practically become instantly solid on heating. In addition to this, there is more or less of a localized, and, in many cases, a generalized edema. I think I can state, therefore, without fear of contradiction, that these patients were really suffering from chronic nephritis.

In the majority of the cases I have so far treated, alterations in the optic nerve and retina have been quite common. In passing, I may be allowed the statement

2. Through an unwarranted error in my laboratory, the quantitative estimation of the albumin in the two cases recorded in my previous paper were incorrectly stated. In that article, whenever the percentage of albumin is given, it should be changed to read "grams" per liter (Esbach) instead of per cent.

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that the thyroid gland will probably prove to be the most effective means so far discovered to arrest these destructive changes in the fundus of the eye. It is not necessary, I am sure, in order to complete the generic picture of this distressing malady, to describe the physical exhaustion and utter weariness of mind which accompanies its miserable progress.

In my former paper, I described this treatment from the point of view of the internist. Now I want to call your attention to its probable value as a preparatory treatment when a surgical operation is necessary in those suffering from nephritis. Correct preparatory treatment for those suffering from diabetes mellitus frequently carries them through their operative procedure with success. Thyroid extract as a preliminary treatment in nephritis, when surgery is a prospect, will also be found to have a large place as the following two cases illustrate:

CASE 1.—Mr. C., aged 69, farmer, always well until two years ago, when he noticed a swelling in left inguinal region. This has gradually grown larger until the discomfort is annoying. Also noticed in the last year, that he was getting short of breath on exertion. The symptom, however, that alarmed him was puffiness of the legs, hands and face. He attributed all his symptoms to the gradually enlarging direct inguinal hernia, and asked for operative relief.

A physical examination showed, in addition to his hernia, a moderate generalized edema with considerable fluid in the abdomen. There was presystolic murmur at apex of heart; heart hypertrophied; apex beat in seventh interspace and outside nipple line. Hemoglobin was 60 per cent. (Dare); blood-pressure 170 systolic, 120 diastolic; weight, 157 pounds; temperature, 98.2 F. The urine: total quantity in twenty-four hours 22 ounces; specific gravity, 1.010; albumin, 4 gm. to liter (Esbach); many granular and hyaline casts. This was Aug. 24, 1912. Admitted to St. Mary's Hospital and put to bed. Desiccated thyroid gland, 2 grains six times in twenty-four hours, and Blaud's mass 5 grains three times a day, were administered. Aug. 30, 1912, total quantity of urine 30 ounces; specific gravity 1.020; albumin 3 gm. to liter (Esbach); fewer granular and hyaline casts, but many are still present. Sept. 7, 1912, total quantity, 35 ounces; albumin, 1.5 gm. to liter; occasional granular casts. Sept. 14, 1912, specific gravity, 1.020; albumin, 1 gm. to liter (Esbach); no granular or hya-

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line casts in centrifuged specimen; a few pus cells. Edema remains the same. Dried thyroid gland tablets (2 grains) increased to ten a day. After a week's treatment by the larger dose, the edema gradually disappeared, as did also the albumin. Treatment continued another week without the reappearance of the cells, albumin or edema.

At this time, a repair of the hernia was made under ether anesthesia. The thyroid-gland treatment was readministered (six tablets in twenty-four hours) at the beginning of forty-eight hours following the operation. The final examination of urine was made at this time. The total quantity for the twenty-four hours was 23 ounces; specific gravity, 1.020; albumin, 1 gm. to the liter; a few hyaline and granular casts in a 1/6 field. Patient was in good condition. At the end of the first week following the operation, the urine contained no albumin or casts, and the patient left his bed at the end of three weeks cured of his hernia and his nephritis, and has remained well until the present time (May 24, 1913).

Case 2.—J. W. A., aged 54, American, railroad contractor, was referred to me with a diagnosis of interstitial nephritis, the symptoms of which had been present for over one year. The patient had had typhoid fever when a young man; malarial fever; bilious remittent fever; left inguinal abscess the previous fall, cause unknown. Knocked from railroad-bridge eight years ago, in bed one week, did not work for one month, says he was hurt inwardly and at base of skull. Was a heavy drinker of whisky and beer twenty years ago, since then only occasionally.

Four months previously he noticed that he had to get up three or four times at night to urinate. Has an impression that he passes too much urine. Last three months complained of shortness of breath on ordinary exertion. Is alarmed because of gradually increasing swelling of both legs below the knees, which has come on within last three weeks. Complains of general weakness, although his appetite is good. Looks sick, but insists that his general health is good. He is convinced that all his trouble is due to a hernia which developed shortly after his fall from the bridge. Has always worn truss with comparative comfort; states that his hernia now interfered with his getting about on his railroad constructive work, and wants it cured.

Examination, March 2, 1912, revealed a well-built man normally of good physique. Temperature, 3 p. m., 98.2 F.: hemoglobin, 65 per cent. (Dare); weight, 179½ pounds; blood-pressure, systolic 190 mm., diastolic 150 mm.; lungs and abdomen negative except for a rather large left inguinal hernia; scar of previous abscess in left groin about midline of Poupart's ligament. Heart: apex beat diffuse and muffled and 1 inch outside of nipple line. Soft edema of both legs below knees.

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Urine: total quantity in twenty-four hours was 20 ounces; specific gravity, 1.010; total solids 340 grains; albumin, 4 gm. to liter (Esbach); many granular and hyaline casts.

Patient put to bed in his home, instructed not to eat red meats, otherwise usual diet. Six 2-grain tablets desiccated thyroid given a day for first week. At end of week, urine had increased to 40 ounces in twenty-four hours; specific gravity, 1.020; total solids in twenty-four hours, 600 grains; fewer granular casts and no hyaline casts were found in centrifuged specimen.

It is unnecessary to burden this article with a detail of the urinary examinations, which covered a period from March 2 to May 12, 1912. It is sufficient to say that this patient's urine was found to be normal when examined April 28, 1912. The experience gained in the previous case of nephritis complicated also with a hernia, made it seem justifiable to operate on this man's hernia. The operation was performed May 16, 1912, at St. Mary's Hospital, by the Bassini-Andrews method. The first forty-eight hours a limited quantity of water was given. The urine examined at the end of this period contained 1 gm. of albumin to the liter, and a few granular and hyaline casts. The dried thyroid gland was again administered, six tablets (2 grains) in the twenty-four hours. In one week the urine was normal, and the convalescence was uninterrupted. The urine of this patient was examined May 12, 1913, one year after his surgical operation, and found to be normal. The patient is in excellent health, and has resumed his work as a railroad contractor.

Before describing the method that I have followed in the dried thyroid gland in nephritis, I wish to present another case that at least offers additional possibilities for the use of this substance. I refer to non-obstructive postoperative suppression of urine.

Case 3.—Mrs. J., aged 43, the mother of four children, gave a history of renal calculus extending over a period of three years. Aside from the ordinary and common pelvic pathology incident to child-bearing, and the history of renal calculus, this woman's history is negative. Roentgenoscopy showed a ureteral calculus near the bladder. High palpation through the vaginal fornix touched a small, hard mass which not only caused considerable pain, but started irritative symptoms in the bladder. This was undoubtedly the same foreign substance shown in the roentgenogram. Under ether anesthesia, in the Galesburg Hospital, Aug. 19, 1910, the ureter was opened and the stone removed through an extraperitoneal incision just inside the left iliac bone; small cigarette drain. The calculus was ¼ inch long and ⅛ inch in diameter, and

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had produced a condition of hydro-ureter. The proximal part of the tube was not over half an inch in diameter. The patient reacted well from the operation, and with the exception of a rather rapid pulse (from 100 to 120), which was attributed to her chronic, but mild, neurasthenia, seemed to be progressing favorably. At the end of forty-eight hours the nurse reported that no urine had passed, and also that there was no bladder distress. The woman was catheterized, and only half an ounce of urine was obtained. Unfortunately, this specimen was not examined. The usual treatment, namely, plenty of water both by mouth and enteroclysis, together with hot packs, free catharsis, strychnin, digitalis and nitroglycerin, was followed for the next thirty-six hours without results, as far as obtaining urine by catheter was concerned. At this time, two 2-grain desiccated thyroid tablets were given every three hours, and all other treatment stopped. No urine having been voided in twelve hours, the catheter was again inserted, and 2 ounces of urine obtained. The specific gravity of this specimen was 1.008, albumin sufficient to make the specimen opaque by the potassium-mercuric iodid test, no sugar or casts, but rather numerous blood-cells. In twelve hours the catheter was again inserted, and 4 ounces of urine obtained. It was of the same general chemical type as that obtained the previous twelve hours. Treatment by dried thyroid gland was continued. Eight hours following the last use of the catheter, the patient passed voluntarily 20 ounces of urine, the specific gravity of which was 1.025, and normal, except for a slight amount of albumin and a few blood-cells. The following twenty-four hours, 50 ounces of normal urine were voided.

We shall all agree that one case cannot have much significance; and yet the history and treatment, as outlined herein, must impress you, as it did me, that the results in this case will justify the further use, in similar cases, of the thyroid gland until its true value can be determined after a trial in a larger number of cases. It is my rule now, and I would earnestly recommend to others to give a 2-grain tablet of the dried thyroid gland six times in the twenty-four hours, for two days, in all cases in which the genito-urinary tract is to be attacked by the knife. My reason for this is not alone the results that I have seen from the use of this gland in nephritis as it ordinarily occurs, but especially its remarkable efficiency in clearing up the albuminuria

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of pregnancy, to which I also referred in my first paper. These experiences have impressed me to such a degree that I am willing to assert that clinically, at least, the desiccated thyroid gland is indicated in all forms of existing, or threatened, urinary pathology that do not come within the list of exceptions which I have already indicated in the first part of this paper.

METHOD OF ADMINISTRATION

In an editorial[3] in THE JOURNAL there is the following caution as to the giving of the thyroid extract in this disease: "If the treatment is determined on, we suggest the use of small doses cautiously increased." Justifiable as is this warning in reference to any new treatment that may have in it possibilities for harm, unfortunately, it has in this instance been the means of destroying the value of the treatment as followed by many practitioners. Small doses, that is, 2 grains of the dried gland every four hours, are absolutely ineffective, and have no apparent effect in arresting the progress of the disease. My own rule is to give six tablets a day for the first week, each tablet representing 2 grains of the dried thyroid-gland substance. If the total quantity of urine is collected each twenty-four hours after the thyroid-gland treatment is commenced, it will be noted that the abnormal characteristics of the urine previous to the treatment are greatly intensified. Not only is the quantity in the twenty-four hours lessened, but there is a marked increase in both the number of casts and in the quantity of albumin; with this, the patient's physical symptoms in many cases, but not in all, are intensified. This disturbance lasts, in those subject to it, not over three days. The elimination of casts and albumin then begins to decrease, and the patient shows physical improvement in a ratio commensurate with the change for the better in his urinary findings. At the end of the first week, my rule is to increase the number

3. Thyroid Extract in Bright's Disease, editorial THE JOURNAL A. M. A., Nov. 9, 1912, p. 1725.

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of tablets (2 grains) to 10 a day. This quantity of the drug, when combined with absolute rest in bed, constitutes the routine in the average case.

The fear of hyperthyroidism is almost groundless while the urine contains casts and albumin. When persisted in after these elements have disappeared, in a few cases I have had a mild hyperthyroidism develop, which disappeared in a week, when thyroid was discontinued.[4]

After the urine becomes normal, I reduce the number of tablets to four or six a day, and give these three weeks out of each month. Whether this is absolutely necessary, or not, I am not quite prepared to say. Most of my early patients have not continued with the treatment in this way, and have remained well. If the high blood-pressure persists, I follow the thyroid treatment with the persistent use of potassium iodid and nitroglycerin, as mentioned in my previous paper. I do this because, clinically, I am quite certain that it has done my patients, with this condition, much good. I am convinced that the administration of the dried thyroid gland in addition to offering a method of efficient treatment to the internist, offers to the surgeon, as well, a means of benefiting his operative cases when nephritis, mild or severe, is one of his problems.

4. Since the publication of my first paper, I have received reports from three colleagues who each had a case of severe nephritis, in their practice, which disappeared spontaneously on the onset of an exophthalmic goiter. Interesting enough, these practitioners made note of the fact, but attached no particular significance to it. The three patients were adults, two women and one man.

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THE TECHNIC OF ROENTGEN-RAY EXAMINATION OF THE GASTRO-INTESTINAL TRACT, AND THE INTERPRETATION OF SCREEN AND PLATE FINDINGS *

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The fundamental principle of Roentgen-ray examinations of the stomach and intestine is the visualization of their outline by filling them with substances opaque to the ray, a principle which we owe to Rieder, of Munich, who, in 1904, first used bismuth subnitrate for the purpose. From this has evolved the present-day technic of radiography of the digestive tract, the evolution being contributed to in minor particulars by numerous roentgenologists, and in major particulars by a few men of whom Holzknecht and Haudek stand out with signal prominence.

The occasional toxicity of bismuth subnitrate soon led to its supersession by bismuth subcarbonate and later the oxychlorid. Zirconium oxid has also been employed to some extent abroad. Chemically pure barium sulphate, because of its cheapness, has come into very general use both for enemas and for the opaque meal.

Bismuth subcarbonate is in common use. By its alkalinity peristaltic activity is depressed somewhat. The oxychlorid being lighter, is consequently better held in suspension. It does not interfere with peristalsis.

The finding of a suitable medium for the administration of the opaque salts by ingestion at the time of

* From the Mayo Clinic.

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examination has given some difficulty. It is desirable that the mixture be more or less palatable, that it be thick enough to hold the opaque salt in good suspension, yet not too thick to fill all recesses, that it be not too stimulative of gastric secretion, and that it do not suppress peristalsis or produce early pyloric closure. When a large number of cases are examined the cost becomes a matter of importance.

The vehicles commonly used include water, milk (plain, condensed or fermented), mucilage of acacia, potato-starch, and various cereals. Each of these has its advantages and disadvantages, depending on the purpose in view. For the six-hour Haudek meal a cereal, such as one of the wheat breakfast foods, with a little sugar and cream or fruit syrup, is desirable. At the beginning of the screen examination a little plain water and bismuth facilitates palpatory outlining of the borders of the stomach, and by not exciting the pyloric reflex can ordinarily be expressed into the cap and duodenum, thus visualizing them. For complete filling of the stomach, preparatory to radiography, the bottled proprietary fermented milks are admirable. They are relished by most patients, hold the bismuth in good suspension, and do not hinder peristaltic action. Mucilage of acacia, freshly made from the powder or gum, is effective, but not pleasant to take. The semi-condensed milk holds up to the bismuth fairly well and is palatable. Owing to its contained fat, peristalsis is much diminished. Two ounces of potato-starch in 6 or 8 pints of water, well stirred and brought to the boiling point (after the Gourevitsch formula) makes an excellent medium. It can be flavored with fruit syrup to suit the taste.

The essentials of an opaque enema are: (1) that the mixture shall not be irritating to the bowel; (2) that it shall be sufficiently large to fill the entire colon; (3) that it shall be sufficiently fluid to flow freely and fill recesses, yet thick enough to hold the bismuth in good suspension.

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Barium sulphate, bismuth subcarbonate and bismuth oxychlorid are each commonly used as a base. Barium sulphate serves the purpose well and is far cheaper than bismuth. Bolus alba (kaolin) is added by some.

For mediums, mucilage of acacia, fermented milk, condensed milk, mucilage of tragacanth, potato-starch, and other vehicles are employed. Any one of them can be used satisfactorily. The potato-starch is more economical, but has the occasional disadvantage of becoming lumpy and obstructing the enema tube unless filtered.

The medium should be from 50 to 60 ounces in amount, should contain from 4 to 6 ounces of bismuth (subcarbonate or oxychlorid) or from 6 to 8 ounces of barium sulphate, thoroughly mixed, should be warmed to or slightly above the body temperature, and should be administered by gravity-pressure from a height of from 3 to 6 feet. The ordinary hard-rubber saline tip is sufficient, the so-called high enema being unnecessary. The rubber tubing should be equipped with a spring-clip cut-off.

After completion of the examination the patient should evacuate the enema at once. I have not found purgatives necessary afterward, nor has caking of the bismuth or barium in the bowel, as mentioned by some radiologists, occurred to my knowledge.

In those cases in which the opaque enema meets with complete obstruction at any point, it may be supplemented by an opaque meal. By watching the progress of the latter the proximal limit of the obstruction can thus be determined.

Proper preparation of the patient for examination is important. In order that the bismuth may fill and outline the stomach and bowel it is obviously necessary that they be evacuated beforehand as completely as possible. In most cases this can be effected by the administration of a saline, or castor oil the evening previous to the examination, and, if an opaque enema is to be

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given, the patient should also wash out the bowel with a soap-suds injection early on the morning of examination. Even with these precautions there will be more or less annoyance to the examiner from gas in the bowel, and the roentgenologist who can devise a technic which will entirely eliminate this annoyance will indeed be fortunate. The patient should abstain from food from the evening previous to examination until after its completion.

A uniform technic in regard to opaque ingesta and injecta will give a stable basis of comparison and greater uniformity of results.

PROTECTION

Fluoroscopy being so advantageous in gastro-intestinal work, attention is directed anew to its possible dangers. With the disasters which have befallen pioneers in Roentgen-ray work fresh in our minds, we have an acute, perhaps exaggerated sense of the hazard attending such work, especially screen work. I would not urge any roentgenologist to take risks which to him seem imprudent and which might possibly result in his injury, but candor compels me to express my very sincere belief that we have gone from one extreme to the other, from extraordinary and ignorant rashness to extraordinary and unnecessary caution. This excessive caution is shown in much of the modern screen apparatus. In the effort to secure protection many of the installations have been made complicated, unwieldy, and often inefficient. Access to the patient for close inspection and palpation has been rendered difficult or even impossible, and the screen examination thus "denatured" loses half its interest and value. In a personal communication, Haudek states that with quite simple apparatus he has screened over 12,000 patients without harm to himself or to them.

The apparatus which I have used for several years, making hundreds of screen examinations in that period,

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without the slightest injury to the patients or myself, of which I am aware is not at all complicated. The tube is encased in a box thickly painted with lead oxid, mounted on a shaft, which is given free vertical and lateral movement by means of counterweights within the upright standards at each end of the shaft. The opening in the tube-box has a rectangular diaphragm. Immediately in front of this is a shield of sheet lead ⅛ inch thick, 7 feet high and 5 feet wide. A central panel of this shield is cut away and replaced by a thin sheet of aluminum against which the patient leans. The screen hangs in front of the patient from an arm attached to the tube-box with which it moves in unison. I usually wear a leaded rubber apron and gloves. A portable switch-table stands conveniently at the left, and a foot-switch on the floor.

After the screen examination, plates are made with the patient in a standing posture, an adjustable tube-stand being used, and the cassette fixed on a movable wooden bracket attached to the wall.

For examinations of the colon we use a lead-lined wooden table, open on the side away from the operator. Beneath this the tube, mounted on an arm, swings freely in every direction in unison with the screen attached to another arm above the table. At the foot of the table is an upright with pulley and cord for adjusting the enema-container at various heights. The top of the table is of canvas, on which the patient lies. The tube has an iris diaphragm.

Before beginning a screen examination the observer will find it advantageous to remain in the dark-room for from ten to twenty minutes in order to give his eyes a maximum of accommodation. He will thus be enabled to see details on the screen which would otherwise be invisible. A pair of closely-fitting, smoked-glass goggles, to be worn whenever it is necessary to turn on the room lights, will help to maintain the accommodation and lessen eye-strain.

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Having taken an ounce of castor oil the evening before, the patient reports in the morning without breakfast. He is then given an ordinary portion of wheat-meal porridge into which two ounces of barium sulphate has been well mixed, together with a little sugar and cream. He is directed to abstain from further food until after the examination and to return six hours later. On his return he is stripped down to the hips; the screen is placed against the abdomen and the presence or absence of residue in the stomach from the morning meal noted.

Next the "head" of the barium column, that is to say, the most advanced position in the intestine of the six-hour meal, is determined. Commonly this will be in the cecum but it may be anywhere from the stomach to the rectum, depending on the patency and motility of the tract.

The patient now drinks rapidly 6 or 8 ounces of water containing 1½ to 2 ounces of bismuth subcarbonate, well stirred. Its entrance and descent into the stomach are carefully watched. When all has been drunk, the observer palpates toward the pylorus and by this effleurage is often able to drive a quantity through into the duodenum, thus visualizing it. He then presses the bismuth in the stomach upward, watching the outline of the greater and lesser curvatures.

Sixteen ounces of potato-starch pap containing 2 ounces of bismuth subcarbonate and flavored with syrup of raspberry are then drunk by the patient. Usually this fills the stomach quite well, outlining it clearly. Irregularities which may have been previously observed with the bismuth water are palpated to determine their nature and permanence. Mobility and peristalsis are also determined.

Two or three plates are now made, the patient standing with his abdomen against the plate-holder, with the upper edge of the plate at or near the nipples.

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A ROUTINE EXAMINATION OF THE COLON

Having taken an ounce of castor oil the evening before, and a cleansing soap-suds enema the morning of examination, the patient strips and lies on his back on the colon-table. The enema, 16 ounces of mucilage of acacia and 3 cans of condensed milk with 8 ounces of barium sulphate, is warmed to body temperature, put into the container and elevated from 3 to 6 feet above the table. The syringe-tip is introduced into the rectum and the flow released by the spring-clip. On the screen the enema is seen slowly to fill the ampulla, then successively the sigmoid, descending, transverse and ascending colons and the cecum, occasionally passing the ileocecal valve into the ileum, and, more rarely, filling the appendix.

The abdomen is palpated at intervals to determine the mobility and elucidate eccentric loops and apparent kinks of the bowel. If definite obstruction, not disappearing on massage is met with, or if the patient complains greatly of discomfort, administration of the enema is stopped.

The plates (14 by 17) are made with the patient standing or reclining, or both.

DIAGNOSTICS OF THE SCREEN-EXAMINATION OF THE STOMACH

Motility.—Mere traces being excluded as unimportant, a distinct residue from the Rieder meal after six hours, no additional food having been taken meanwhile, is a valuable diagnostic indication. A small residue, up to a quarter of the meal, may be found in atony and hyperacidity, but organic disease must not be overlooked. A large residue of half or more of the meal often signifies obstruction either at the pylorus or in the duodenum. It may occur in carcinoma involving the pyloric end of the stomach, in pyloric and duodenal ulcer with contraction or adhesions, and in adhesions about the gall-bladder, stenosing the duodenum or pylo-

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rus. A residue associated with hyperacidity is sometimes found in gastric ulcer.

In carcinoma not obstructing the pylorus, clearance is early. Here there is commonly the accelerating factor of achylia, and not infrequently the pylorus is gaping, as though stiffened by infiltration. The *head* of the bismuth-column in the intestine, usually in the cecum or ascending colon after six hours, may be advanced by low gastric acidity to the transverse colon, the splenic flexure, or even beyond, while with gastric hyperacidity the head is often in the ileum. The position of the head is therefore a gross measure of acidity, if no mechanical obstruction exists. If barium be used in the Rieder meal, the head will usually be found farther advanced than if bismuth is used. After six hours the barium will quite commonly be found in the transverse colon.

Form.—It has been remarked that the stomachs of different individuals as seen by the Roentgen-ray vary in shape as much as their faces do. Nevertheless, the vast majority fall into two general classes—the "fish-hook" and the "steer-horn." Each of these has its variations, to some of which distinctive names have been applied. The "fish-hook" form, the "J" shape, is that most commonly met with and seen. It occurs in nearly all women and in many men. The "habitus enteroptoticus" of Stiller, characterized by a long, narrow trunk and a narrow costal arch, is usually accompanied by a "fish-hook" stomach. Ulcer is found more often in the "fish-hook" than in the other type. The "steer-horn" (or cow-horn) stomach is aptly described by its name. It occurs rather frequently in men and occasionally in women, its possessor nearly always having a short, broad trunk and a wide costal arch. The "steer-horn" type is more often associated with carcinoma than the other type.

Hour-glass stomach is the name applied to a striking and important deformity of the organ. Sometimes this

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is produced by spasm of a bundle of circular fibers, not quite completely dividing the stomach into two chambers, both of which are rather symmetrical with regular outlines. The spasmodic hour-glass can often be made to disappear by vigorous palpation, the patient being asked to breathe with open mouth and his attention being thus distracted. In long, ptosed stomachs the first swallows of bismuth are sometimes held up momentarily in the funnel-shaped cardia, then drop through into the more expanded lower segment. This condition should not be confounded with hour glass stomach.

Organic hour-glass stomach may be produced by adhesions or the scar contraction of ulcer, or by the deforming effect of carcinoma. The segments (loculi) are usually unequal in size, asymmetrical, and irregular in outline. In carcinoma the canal between the segments is usually longer than in ulcer and more or less central between the curvatures; it is short in ulcer, as a rule, and nearer to the lesser curvature. Hour-glass stomach may be overlooked if filling of the lower segment is greatly retarded.

Diverticulum.—Hour-glass deformity frequently, but not always, accompanies perforating ulcer with diverticulum. The perforation may be anteriorly into the liver, or posteriorly into the pancreas, and the cavity formed by the continuation of the ulcerative process in these organs is the diverticulum. It shows on the screen as a sort of miniature stomach, of varying size, just outside the outline of the stomach, usually on the lesser curvature, but may also be seen on the anterior or posterior wall, with a layer of bismuth and a layer of less dense fluid, surmounted by a gas bubble. Whether the diverticulum be in the liver or the pancreas may sometimes be determined by rotating the patient, the horizontal arc of movement being greater in the latter instance. Diverticulum in the liver, being closer to the screen, is sharper in outline than diverticulum in the pancreas and shows respiratory excursion.

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A bismuth residue will often remain in the diverticulum after the stomach is empty.

Position.—With the patient standing, the position of the stomach depends somewhat on its form. A "steer-horn" stomach passes obliquely downward across the spine, while the cardia and media of a "fish-hook" stomach usually hang vertically, the pyloric end crossing the spine and curving upward. Between these are numerous normal variations. The lower border of the average bismuth-filled stomach is at or near the umbilicus, but the type must be taken into consideration, the "steer-horn" being often above, and the "fish-hook" at or below. An inch above and an inch to the right of the umbilicus is an average position of the pylorus. This corresponds nearly to the second lumbar vertebra. The point has been made that, as the cardiac end of the stomach is fixed, genuine gastroptosis seldom exists. Elongation of the stomach with the lower pole down even to the pubic arch is not uncommon, especially in women.

The pylorus may be displaced to the left by the contraction of an ulcer-scar on the lesser curvature, upward and to the right by periduodenal and pericystic contractions, and downward in association with splanchoptosis. In pyloric stenosis it is frequently seen displaced to the right.

Tonus.—This is the degree of ability of the stomach so to contract on its contents as to maintain a tubular form until empty. Degrees of tonicity are designated as hypertonic, orthotonic, hypotonic and atonic.

The hypertonic stomach supports its contents with a firm grasp. Either type may be hypertonic; the "steer-horn" is almost constantly so. The orthotonic represents the normal or average tone while the hypotonic is undertone, usually having a broader lower pole, and is seen more often in the "fish-hook" type. The atonic stomach, completely without tone, unable to hold up its contents in columnar form, hangs as a flaccid bag, with its

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vertical walls usually in apposition. It is seen typically in pyloric obstruction with the lower pole expanded into a wide basin and the vertical segment of the stomach unfilled.

Gas Bubble.—At the upper end of the cardia is a clear, dome-like area, its base on a level with the esophageal opening. This is the gas bubble (*Magenblase*). Its size varies considerably. In aerophagy, in carcinoma and in neurotics it may be quite large. In unfilled, ptosed stomachs its shape may be fusiform and its size quite large.

Mobility.—Except its cardiac end, the normal stomach can be moved about quite freely. Fixation, or restricted mobility, is therefore of significance. Adhesions from penetrating gastric ulcer or new growths may be the cause. At the pyloric end an inflammatory process about the gall-bladder, or about an ulcer of the duodenum may lessen the normal range of movement.

Peristalsis.—A normal peristaltic wave appears as a shallow indentation on the greater curvature at or near the incisura cardiaca (an indentation marking the juncture of the cardia and media), and travels slowly toward the antrum, growing deeper as it progresses. On the lesser curvature the wave travels a much shorter distance to the incisura angularis (a depression at the beginning of the antrum), is deeper than its fellow on the greater curvature, and apparently slightly in advance of it. The antrum seems to efface itself by concentric contraction, and is immediately succeeded by another, the formation of which is in progress while the old antrum is disappearing.

Average peristaltic waves occur at intervals of from ten to twenty seconds. Sometimes three or four may be seen simultaneously. Peristaltic activity is increased by high acidity. It can be stimulated by palpatory manipulation, but quickly subsides. In atonic, dilated stomachs the number and depth of the waves are greatly diminished. In pyloric and duodenal obstruction of

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recent existence the waves may be tremendously exaggerated, almost bisecting the stomach. In carcinoma a wave will progress to an infiltrated area, skip it, and take up its course again in the unaffected wall beyond.

The character of the opaque ingesta employed often materially influences peristaltic action as to force and frequency.

Antiperistalsis.—This, as observed first by Jonas, is described as a less active wave-like movement in the reverse direction, sometimes coexistent with normal peristalsis, seen occasionally in pyloric obstruction and in other organic lesions of the stomach. In many hundred examinations of the stomach I have never seen this phenomenon.

Secretion.—Below the gas bubble, at the top of the bismuth column, may be seen a defined layer of fluid less opaque than the bismuth pap. The depth of this layer is regarded by some as an index of the stomach's secretory activity. When the bismuth is given in solid mediums, this opinion is no doubt well founded, but if watery mediums are used, out of which water may separate, the result is open to question.

Kaestle's capsules are sometimes used to determine the amount of secretion in an otherwise empty stomach. They are given in pairs, a "sinking" and a "swimming" capsule, each containing enough bismuth to be visualized by the Roentgen-ray. The vertical distance between the "sinking" capsule at the bottom and the "swimming" capsule on the surface of the secretion shows its depth. Objection may be made, however, that the amount of secretion would also depend on its surface extent, which in turn would be governed by the broad or narrow curvature of the lower pole. After swallowing the capsules the patient may be allowed to chew appetizing morsels of food, but not swallow them, thus stimulating secretion. Secretion is far more accurately determinable by the gastrologist, however, than by the radiographer.

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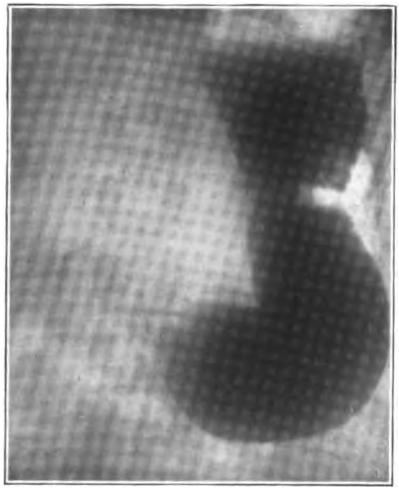

Fig. 1 (A—80973, X-ray 19835).—W. E. W., woman, aged 44. Radiogram shows a "fish-hook" stomach. There was no residue after six hours. It shows a projection on the lesser curvature, which is the bismuth-filled crater of a callous ulcer, and a marked transverse contraction of the greater curvature (incisura) opposite this niche. Diagnosis: Callous ulcer on lesser curvature. Operation: Excision of ulcer on lesser curvature about 5 inches from pylorus with surrounding fibrous tissue; gastroduodenostomy. Pathologic report: Gastric ulcer, scar tissue. (Clinically, this patient's symptoms were quite insufficient to establish the diagnosis and she was about to be sent home when an x-ray examination was made.)

Fig. 2 (A—83115, X-ray 20799).—A. C., woman, aged 62. Radiogram shows "fish-hook" stomach with a moderately large projection on the lesser curvature which was regarded as a perforating ulcer. No transverse contraction seen. Small residue after six hours. Operation: Resection one-half middle of stomach; end-to-end union. Pathologic report: Carcinomatous ulcer with glandular involvement.

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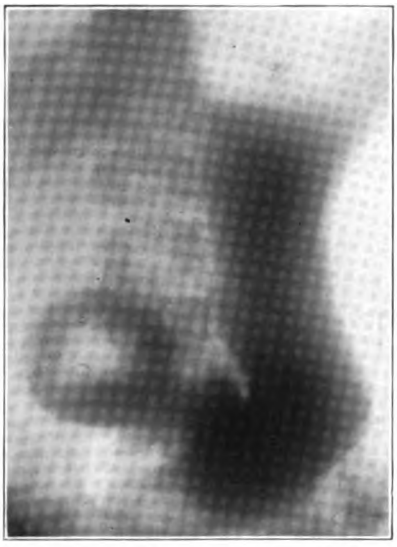

Fig 3 (A—80993, X-ray 19816).—Mrs. J. K., aged 37. **Radiogram shows cap and duodenum visualized throughout, with lagging of bismuth. No residue after six hours. This picture is frequently seen in duodenal ulcer and illustrates the necessity of correlating the x-ray with the clinical findings. Operation: Cholecystectomy for typical strawberry gall-bladder with a diverticulum.**

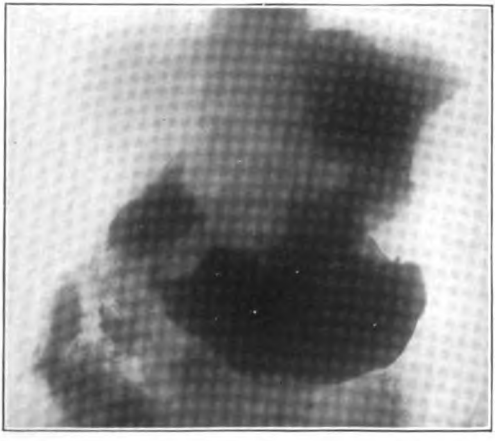

Fig. 4 (A—74843, X-ray 17585).—O. H. L., man, aged 57. Radiogram shows marked filling defect of the pars cardiaca and media. Possible carcinoma of stomach. Operation: Carcinoma, cardiac end of stomach. Extensive glandular involvement. Also metastasis in pelvis.

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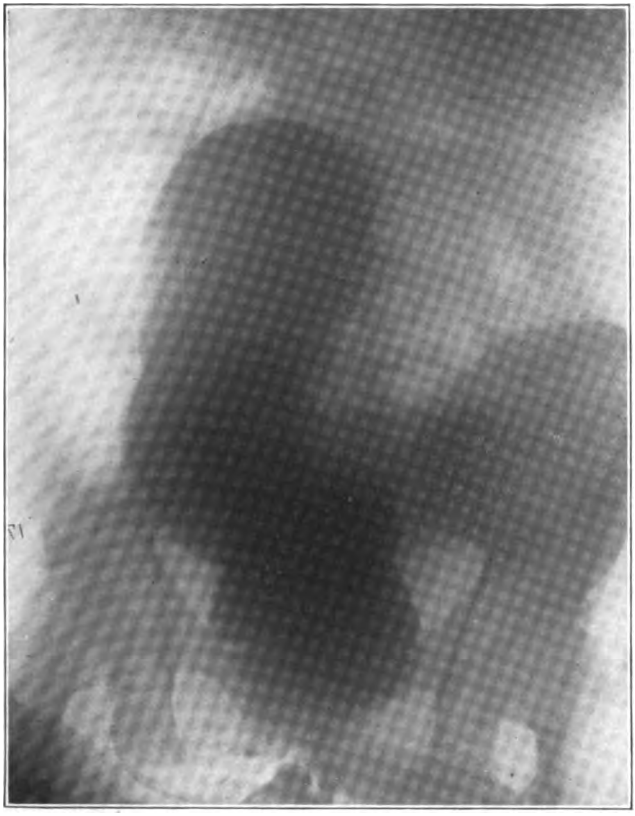

Fig. 5 (A—80026, X-ray 19406).—R. B. B., man, aged 37. Radiogram shows obstruction of descending colon and sigmoid, probably due to tumor. Exploration: Tumor of sigmoid 7 inches long fixed to the bladder and left side of pelvis. Inoperable carcinoma.

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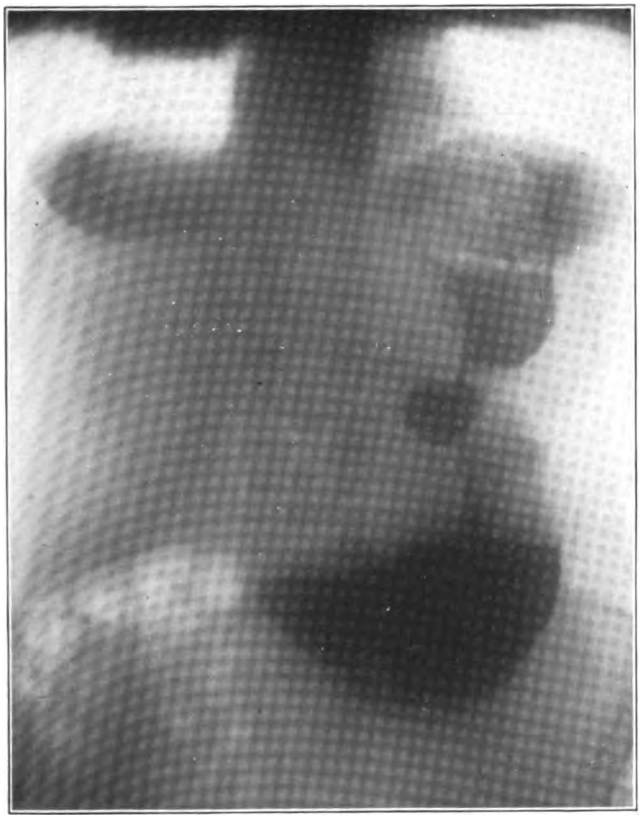

Fig. 6 (A—77396, X-ray 18393).—Hour-glass stomach, "fish-hook" type, displaced to the left, extending below umbilicus, showing diverticulum just outside stomach outline on lesser curvature. Diverticulum contained bismuth after the upper loculus had emptied. Diagnosis: Diverticulum due to perforating ulcer of the stomach. Operation: Perforating gastric ulcer of stomach, perforating into the liver.

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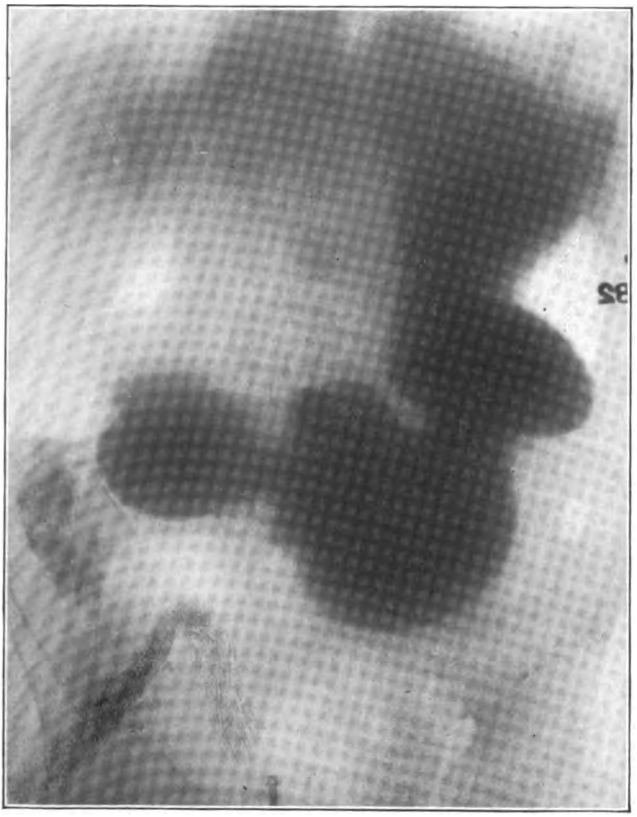

Fig. 1 (A—79785, X-ray 19282).—D. A. C., man, aged 52. Screen showed a large six-hour residue. Tremendous peristalsis showing 3 cycles. Diagnosis: Pyloric obstruction. Operation: Large duodenal ulcer, size of a penny Very marked obstruction, lumen reduced to size of a lead-pencil. Operation Heincke-Mikulicz type, without pyloroplasty.

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Fig. 8 (80853, X-ray 19797).—Marked redundancy of sigmoid with loop folded on itself. Marked obstruction transverse colon near splenic flexure, no bismuth going beyond point of obstruction. Remainder of transverse, ascending colon and cecum contain a small amount of colonic gas. Diagnosis: Probable tumor of transverse colon. Operation: Carcinoma of transverse colon.

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Pylorus.—Immediately after giving the bismuth-water this can usually be expressed by the effleurage into the first portion of the duodenum—the cap. The pylorus will then be shown as a clear disk, from an eighth to a quarter of an inch thick, seen edgewise, with a central narrow column of bismuth joining that in the cap and the antrum.

Pylorospasm from hyperacidity, or from numerous reflex causes, such as lesions of the gall-bladder, chronic appendicitis, nervousness, fright, etc., may make it difficult or impossible to press the contents of the stomach beyond the pylorus and thus localize it. Duodenal ulcer is frequently associated with a freely patent pylorus, evidenced by the ease with which the bismuth passes through it or can be pressed through it. I have found that pressure over the right iliac fossa will often be followed by upward retraction of the stomach and free flow of its contents into the duodenum.

Filling Defects.—A filling defect is an irregularity of outline caused by the encroachment of an intrinsic tumor on the lumen of the stomach. In medullary carcinoma the visualized periphery of the lumen, instead of its normally smooth outline, may show a gnawed, ragged, notched, irregular appearance, sometimes corresponding to a palpable tumor-mass at that point. Either curvature or both may be involved. The "steer-horn" stomach with an infiltrating scirrhus carcinoma may be narrowed to an eccentric-looking curved funnel, defective filling being evident, though the walls are only slightly uneven.

A true filling defect must be determined by palpation after the water-bismuth has been taken, and again after the pap. It must be differentiated from the irregularity produced by an adjacent gas-filled colon, such as is noted frequently at the splenic flexure. Alterations of the contour of the stomach by adjacent extrinsic tumors are not easily distinguished from those due to intrinsic lesions. Filling defects may be produced by

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gummas of the wall of the stomach. These cannot always be differentiated radiologically from carcinoma. Even though fairly regular in outline, an extraordinarily small stomach, especially if short, is open to suspicion.

Incisurae.—In the outline of the stomach, especially on the greater curvature of the pars media, there is sometimes seen an abnormal indentation of varying width and depth, with its upper and lower borders commonly parallel, its apex rather more blunt than that of a peristaltic wave and not moving toward the pylorus. This transverse contraction is the incisura, first pointed out by Reiche as an index of gastric ulcer. Its production is believed to be due to the irritation from the ulcer or its scar, causing spastic contraction of the circular muscle-fibers at that point.

An incisura may occur transitorily, disappearing of itself or after palpatory manipulation. Eisler has seen these transitory incisurae in small ulcers and erosions. Some roentgenologists question the significance of the fleeting phenomenon and believe that it may result as a reflex or functional disturbance. Leaving this aside, however, a typical incisura, showing more or less persistence, not disappearing on manipulation, and found at repeated examinations, is generally accepted as diagnostic of ulcer, especially if it corresponds to a pressure-pain point on the lesser curvature. At this latter point there may sometimes be seen a bud-like projection, the bismuth-filled crater of an ulcer.

Double incisurae have been found, associated with double ulcer. However, I myself have not seen this phenomenon. Incisurae must be distinguished from the two normal incisurae seen in the bismuth-filled stomach, the incisura cardiaca and the incisura angularis previously mentioned. A deep peristaltic contraction, seen only on the plate, may be mistaken for an incisura.

Duodenum.—By expression of the water-bismuth in the manner previously mentioned, the superior hori-

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zontal portion of the duodenum, the bulbus duodeni, or cap, is visualized. Ordinarily it shows as a small cone with its base directed downward and separated from the stomach by the pyloric ring. It is subject to variations in size, position and outline. Normally regular, it may be distorted by ulcer of which it is a common seat. Bands of adhesions from the gall-bladder may produce irregularities or displace it, usually upward. The first portion of the duodenum, having a smooth inner wall, shows a regular outline when filled with bismuth. The second and third portions show the inward projections of the valvulae conniventes.

The normal duodenum empties itself with great rapidity. Residue from the bismuth-water or pap may remain proximal to a stenosis from ulcer or adhesions or from spasm. Residue in the cap may or may not be of significance. The residue here spoken of should not be confounded with the residue from the six-hour Rieder meal previously discussed, although this also may rarely be seen in the duodenum. The duodenum normally empties itself so quickly that the bismuth-water is merely glimpsed on the screen in passing and rarely shows on the plate. When the bismuth-water tarries long enough to visualize the duodenum throughout for a minute or so, or is held at any point long enough to outline itself definitely on the screen or appear on two or three plates, I am accustomed to speak of it, a little loosely, perhaps, as residue. In such cases the duodenum may sometimes be seen either on the screen or plate as a three-quarters circle, an appearance not infrequently seen in duodenal ulcer. Residue may accumulate proximal to a stenosis from ulcer or adhesions or from reflex spasm, or from kinking at the duodenojejunal juncture.

Quite commonly the cap is vertically above the pylorus, especially in "fish-hook" stomachs, and with the patient in a standing position bismuth tends to collect in the cap, simply by means of gravity, sometimes

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in a thin disk-like layer above the pyloric ring. With "steer-horn" stomachs the cap is often in the horizontal axis of the stomach and no disk-like residue accumulates in it. A kink at the duodenojejunal juncture may be evidenced by residue in a dilatation proximal to it. Peforating duodenal ulcer has been found with a diverticulum, similar to that of gastric ulcer. A tender pressure-point on the duodenum may assist in arriving at a diagnosis of duodenal ulcer, but is not necessarily pathognomonic, and its importance should not be overestimated.

Jejunum.—When filled with bismuth the jejunum shows its wave-like valvulae. Outlines are indistinct. Peristalsis is active and masses of bismuth are pushed forward rapidly at intervals.

Ileum.—Somewhat irregular in its upper half by reason of its valvulae, the ileum becomes smooth and regular in its lower portion. Its terminal loop commonly dips into the pelvis and ascends to join the cecum at an acute angle. Here it may be narrowed by pericecal adhesions, particularly from appendicitis. There is a tendency for bismuth to collect in the terminal coils of the ileum, and opinions as to obstruction here should be cautious.

THE COLON

Size.—It is to be remembered that the average colon diminishes in diameter from the cecum to the sigmoid. While the cecum and ascending colon are relatively larger than the rest of the bowel, they are sometimes abnormally dilated as a result of fecal stasis. The descending colon is frequently quite narrow with sharply marked haustra. The length of the colon varies considerably in individuals, and redundancy of the sigmoid and descending or transverse colons is often encountered, especially in persons who complain of constipation.

Position.—Eccentricities of position most frequently seen are ptosis of the transverse colon, usually accom-

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panied by redundancy, and displacement upward or downward of the cecum. Nonrotation of the cecum is an abnormality occasionally observed, the entire colon occupying the left side of the abdomen. The splenic flexure is least subject to alteration of position.

Patency.—Obstruction to the inflow of the opaque enema may be observed on the screen. If due merely to spasm this soon relaxes. A tumor may have a narrow central channel, proximal to which the colon again shows its normal breadth. Filling defects about the cecum, due to adhesion-producing inflammation, are not uncommon. Fecal scybalae may produce apparent filling defects in the colon. Marked spastic narrowing for a considerable distance is quite often seen, especially in the descending colon and sigmoid. Usually information can be gained from the opaque enema regarding external fistulas. Diverticula have been diagnosticated by this means.

Mobility.—Most of the colon is accessible to palpation, and abnormal variations in mobility can thus be determined while screening. This is of especial value in the cecal region, where the normal mobility of the cecum may be greatly restricted by adhesions.

Peristalsis.—The examiner will rarely see peristaltic action. Opinions have differed as to whether the analward movement of the colonic contents is by infrequent but rapid propulsion in mass, or by slow vermicular progression, or both.

Ileocecal Valve.—In a fair proportion of cases the opaque enema will go beyond the valve into the ileum. Whether this incompetence has any pathologic significance is yet to be decided.

Appendix.—Now and then the enema fills the appendix, visualizing its lumen and giving some information of its length and position. Bismuth is slowly evacuated from it, and traces may remain for days.

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SIGN GROUPS

The various diagnostic indications above discussed may be synthesized into sign complexes. For example, the radiologic evidences of gastric ulcer comprise:

1. The diverticulum of perforating ulcer.
2. Visualization of the bismuth-filled crater of a callous ulcer.
3. The incisura, or transverse contracture, indenting the greater curvature.
4. Localized-pressure tender point on the lesser curvature.
5. Residue after six hours.
6. Acute "fish-hook" form of the stomach, with displacement to the left and down.
7. Delayed opening of the pylorus.
8. Settling of the bismuth to the lower pole of the stomach, such as is seen in hypotonicity or atony.

The Roentgen-ray signs of gastric cancer include:

1. Filling defects.
2. Diminution in size.
3. Lessened mobility.
4. Stiffening and gaping of the pylorus, as shown by a free and continuous outflow of bismuth from the stomach.
5. Absence of peristalsis from affected portions of the wall of the stomach.
6. Antiperistalsis.
7. Residue after six hours, if the pylorus is obstructed, or, on the other hand,
8. If the pylorus is unobstructed, hypermotility, with early clearance of the stomach and an advanced position of the six-hour meal in the intestine.

In duodenal ulcer there may be:

1. Early free opening of the pylorus, with early clearance of the stomach.
2. Lagging of bismuth in the duodenum.
3. Residue in the stomach (sometimes in the duodenum) after six hours, if there is an obstruction from scar contraction.
4. Pressure-tender point over the duodenum.
5. Dilatation of the cap.
6. Irregular outline of the cap or duodenum.
7. Diverticulum of perforating ulcer.
8. Vigorous peristalsis, especially if there is obstruction.

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Radiologic diagnosis of duodenal ulcer, unless corroborated by clinical data, is in most instances a mere guess. Excluding obstructive cases, the Roentgen-ray appearance of duodenal ulcer is often seen when the actual lesion is elsewhere, as in the appendix or gall-bladder.

INTERPRETATION OF THE PLATE

Discussion of the relative superiority of the screen or the plate is useless. There is no competition between them. Each serves certain purposes. Both are necessary for satisfactory gastro-intestinal work.

The plate gives a permanent record. It gives finer detail, and permits longer and closer study of minutiae than does the screen. Stereoscopic plates are especially interesting and valuable in many instances.

Recording, as it does, a single momentary phase of the conditions, interpretation of the plate must be guarded. Compression of the stomach between the spine and the plate may produce an apparent filling defect of the pyloric end of the stomach or even an apparent hour-glass. Incessant systole and diastole of the antrum make it appear vague and indefinite on the plate.

Bismuth poorly suspended may settle irregularly and give rise to the appearance of filling defects on the plate. What seem on the plate to be kinks, narrowings or obstructions of the small or large intestine, are very rarely such. Even serial plates have an element of uncertainty.

Mobility, peristalsis, the presence or absence of deformities, filling defects, or incisurae, must all be determined by the screen examination, during which every phase of movement can be seen, the patient can be turned about for vision at different angles, and the effect of palpation can be noted.

METHOD OF RECORDING FINDINGS

At intervals during the screen examination, the observer or his assistant hastily notes on a scratch sheet the more important facts elicited, together with any

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striking features of the anamnesis. Most of this is easily done by checking or underscoring the appropriate item. The form which I show here (Fig. 9) also provides for the gastric analysis, which findings are usually entered beforehand. Making notes while screening is rather trying on the eyes, and I have occasionally used a dictagraph.

Case No. A _____ X-Ray No. _____

Name _____ Age _____

Date _____

Chemical { Total Acidity, Free Hcl, Comb. Hcl, Lactic Acid

Habitus N. E.

Residue O. 1. 2. 3. 4.

Head I. C. H.F. T.C. S.F D. S.

Peristalsis Nor. Active. Vigorous. Not Seen.

Cap Seen Size 1 2 3 Reg. Irreg.

Duod. Visualized. Immediately Delayed.

Antrum Seen, Regular, Irregular,

Mobility Free, Slightly Fixed, Fixed

Filling defects Card. Media. Pylorica GC. LC.

Incisura Card. Media. Pylorica Transient

Hour-Glass Stomach Organic. Intermittent.

Tender Point L.C. Duod. G.B. McB. Epig.

Clinical Data:

Fig. 9.—Scratch sheet for use during screen examination.

From a comparison of the screen findings with the plates the final conclusions are drawn. These are entered, mostly by underscoring, on the permanent record sheet here illustrated (Fig. 10). The small letter before an underscored item is entered in its proper column on a recapitulation-sheet, from which information can be readily derived for statistical purposes, but it also promotes thoroughness of observation by its constant reminders.

Visualization of a cancer of the stomach with obvious filling defects, or a gastric ulcer with a characteristic incisura or a niche is so dramatic that the exuberant enthusiasm thus aroused has unfortunately created the impression in some quarters that the Roentgen-ray is

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ready to supersede the ordinary clinical methods of diagnosis. This impression should be discouraged, for in the vast majority of instances the ray is only a link in the chain. The x-ray is not a rival of clinical methods, but a most valuable adjunct thereto, and worthy of routine employment.

To maintain a proper conservatism in the interpretation of roentgenologic findings is difficult, yet absolutely necessary. We should remember, among other things, that only a very small percentage of those who complain of gastric symptoms have gastric lesions.

Roentgenologists have reason to be proud of the tremendous advances which have been made in the radiology of the digestive tract, but it behooves us to be careful that the record shall not be marred by overenthusiasm or by long lists of conclusions drawn from short lists of cases.

The Roentgen-ray findings, unless extraordinarily marked and decisive, should be correlated with the anamnesis, the laboratory reports, the clinical data, and always with common sense. There are cases of ulcer and cancer of the stomach and obstruction of the bowel in which the combined fluoroscopic and skiagraphic findings are of themselves sufficiently determinative to justify a diagnostic opinion. But there is a greater number of cases in which the combined x-ray examination will merely elicit suspicious or even only eccentric appearances, a percentage of these being due to real lesions, a larger percentage accompanying only functional disturbances. Here opinions should be advanced with the greatest caution, and the final diagnosis should rest on all the evidence obtainable from every source. This necessitates an extensive correlation, a broad knowledge based on experience, and a careful judgment.

ABSTRACT OF DISCUSSION

DR. ARCHIBALD MACLAREN, St. Paul: Plate machines and coils occasionally will take stomach and intestine pictures that are really very good; but both of these machines are so unreliable that they cannot be depended on. After spend-

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ing a large sum of money for the largest coil made I had to throw it away because it would not make the kind of pictures that I wanted. The only machines that are certain are those of the dynamo type, of which there are three or four good makes on the market.

I wish to confine my remarks to one phase of this question, and that is gastroptosis. When Goldthwaite of Boston showed the first stomach and intestine picture some years ago, before the Ramsey County Medical Society, we were stimulated to see whether we could not get pictures of the stomach and intestine which were worth while. With the Snook machine my associate, Dr. Daugherty, commenced to take pictures of the stomach, and found first, that it was much lower than we had supposed and much lower than we had seen it even on the operating-table. The next thing of importance was the relaxation of the pyloric end of the stomach. The first cases in which we made these pictures were mostly of young women of the neurasthenic type, who had failed to get well after operation in our own hands for a chronic relapsing appendicitis. I have seen many of these cases, and without the stomach pictures we have not been able to be sure that they were cases of chronic appendicitis.

The statement has often been made that it takes a year to get over the operation for chronic appendicitis, but that is not true; many of these slow cases after operation never had any trouble with the appendix. That is the type which the internists and neurologists ever since the time of Weir Mitchell have been curing with the rest-cure. Put those patients to bed when they have these relaxed atonic stomachs, give them six meals a day, and they get well much better than they do after an operation.

Dr. James T. Case, Battle Creek, Mich.: Dr. Carman did not discuss the relative value of roentgenography and roentgenoscopy. I believe he relies considerably on screen examination. I should like to ask him, in closing, to make a statement as to his practice. Roentgenograms present a very nice map of the static conditions present, but give relatively little of the information obtainable by means of fluoroscopy when one employs intelligent manipulation of the bismuth shadows under the guidance of the fluorescent screen examination.

A laxative is recommended by Dr. Carman before each examination, both before the bismuth meal examination and before the injection of the bismuth clysma. My idea is that it is best to omit laxatives. We want to examine the patient as he lives from day to day, and therefore in studying gastrointestinal motility, I think that it is important not to give laxatives before the bismuth-meal examination. The bismuth injecton gives but little information as to the motility of the bowel.

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Dr. Carman said that he attached small importance to the fact that the appendix is occasionally shown in the plate. Whether or not it is pathologic for the bismuth to pass into the appendix, I am not sure, but the fact remains that when the shadow of the bismuth can be seen in the appendix, a number of facts may be ascertained with very great accuracy. The size and shape of the lumen of the appendix; whether it is narrow near the cecal end and likely to be the seat of stasis, or whether it is broad uniformly throughout its length; whether the bismuth remains in the appendix for only a few hours or for fifteen or twenty days; the position of the appendix—whether it is retrocecal, down in the true pelvis or adherent, and other such facts may be ascertained. Accurate identification of a localized pressure pain-point in the appendiceal region is often possible by this method. That this information is frequently obtainable is obvious when I tell you that one-fifth of the cases I have examined following a bismuth meal, in which the appendix has not already been removed, show a patency of the appendix. I now have over two hundred and fifty individual cases in which the appendix has been patent and, therefore, capable of being studied.

Dr. C. E. Ruth, Des Moines, Iowa: I believe that we somtimes make mistakes in reading these findings. I have felt several times that, while I had my information in advance of what the picture was supposed to show, I had better have the man who took the picture interpret it for me. I was glad to hear what Dr. Carman said with reference to exploratory operations, to determine what is the matter in the abdomen, having been too frequent in the past. Many of the patients with chronic appendicitis who have been operated on are in no sense relieved because there was nothing wrong with the appendix originally or because of adhesions or complications that resulted from the operation. Only a few days ago a patient came to me who was operated on five years before, with absolutely no relief whatever from the symptoms of supposed appendicitis, for which the appendix had been removed. A good fluoroscopic and roentgenoscopic examination gave us a picture that showed the cause of the trouble. The cecum was low and the colon had doubled back on itself forming an acute angle at the hepatic flexure then down into the pelvis, thence upward at another acute angle to the left somewhat near the normal position of the hepatic flexure. It was impossible to get the bismuth to pass in any considerable quantity. At a point almost on a level with the normal site of the iliac crest, there was a sharp angulation as the transverse colon attempted to reach the splenic flexure. We diagnosed a band causing partial obstruction at this point. The operation showed the band to be present. It was omentum as large as my finger passing from what we believe to be the

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normal position of the middle of the transverse colon down to the right iliac fossa, being anchored there firmly. It was quite evident that this was the result of the omentum having been forcibly drawn down and secured by suture or other means at the time the operation for supposed appendicitis was done or, having been present before, was the cause of the symptoms supposed to be produced by appendicitis. The patient experienced relief as soon as the discomfort from the operation was passed which released this band. From the many roentgenograms that have been taken recently I feel that we must reduce at least by half the exploratory operative undertakings that have been made in the past, until we have secured a good picture of the condition of the stomach and colon and have evidence that will enable us to plan for an operation intelligently, and that we must do this before we have opened the abdominal cavity and pawed over its contents for half an hour to get an intelligent idea of the needs of the case.

Dr. B. W. Sippy, Chicago: The maximum benefit from roentgenoscopy is to be obtained only in conjunction with careful clinical work. If we are to avoid numerous mistakes in our work, we should compare the roentgenoscopic findings with most careful clinical observation. We must not leave out any of the older methods of determining the conditions present if we wish to succeed. The Roentgen ray alone, as Dr. Carman stated, may lead to serious mistakes.

One word as to the use of atropin in connection with spasm. We have been led to believe that spasmodic contractions of the stomach and bowel will almost invariably show a great tendency to become relieved if we give atropin or belladonna. I want to report one case in which that was most deceptive. The roentgenogram showed an hour-glass stomach. It was a beautiful picture, taken by a competent man. The patient was referred for operation. Three or four pictures taken in succession showed the hour-glass stomach almost in the same position each time. Two or three weeks afterward the condition present was the same. There were no clinical symptoms and a careful analysis of the case showed that there had been pain present almost as in gall-bladder disease, but other symptoms were not present—nothing in the blood-vessels or stomach-contents; in fact, observing the patient for a week at a time failed to elicit any clinical evidence of disorder of the stomach, and still the pictures showed the hour-glass stomach, no matter whether a plate or the screen was used in the examination. Under three weeks' use of atropin and belladonna, pushed to physiologic limit, the hour-glass condition still existed in the same position. The picture showed this hour-glass stomach continuously and justified surgical intervention. This one case shows positively that the Roentgen

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ray is either of enormous value or absolutely worthless. The operation showed that there was nothing wrong with the stomach at all. There was a persistent spasmodic condition of the stomach lasting for four weeks, and it remained absolutely unchanged by enormous doses of atropin and belladonna.

DR. M. F. PORTER, Fort Wayne, Ind.: Had a picture been taken of that stomach prior to the operation, while the patient was anesthetized, a diagnosis of absence of hour-glass contraction of the stomach would have been made. It is a good plan occasionally to take a picture under anesthesia.

DR. R. D. CARMAN, Rochester, Minn.: With reference to Dr. Case's remarks about the use of the screen I wish to say that all our patients are screened carefully. Plates are made only for reference purposes and to detect those details which might be overlooked on the screen. In regard to the use of cathartics, we would rather have the stomach empty and be able to exclude a filling defect due to cancer, than to know anything about the motility. This can be much more accurately determined by the gastro-enterologists. With reference to the appendix, I do not think we need worry about that. MacCarty observed only five or six normal appendixes in his examination of over 25,000 specimens. In the hour-glass stomach, which Dr. Sippy mentioned, I think possibly the contraction was due to a small ulcer or erosion which was not detected by the surgeon. These small ulcers or erosions which may produce a persistent hour-glass contraction of the stomach, even not affected by enormous doses of atropin and belladonna, such as were given in this case, could be easily overlooked. There certainly must have been an ulcer or erosion in this case.

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THERAPEUTIC POSSIBILITIES OF TRANSFUSION

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On the very suggestion of the word "transfusion" one's imagination immediately conjures up an individual clinging desperately to a life that has been all but snatched from him as a result of accidental hemorrhage, postoperative hemorrhage or one of those tragic depletions that not infrequently occur in the course of certain well-recognized conditions, such as extrauterine pregnancy, gastric ulcer, etc. And there is ample justification for this; transfusion is at present an emergency operation—an operation to which one resorts with relative infrequency and only when the patient is in the direst straits. The brilliant results that have been achieved despite the unpromising conditions under which we perform it are proof, if proof be needed, of its helpfulness.

I was recently reviewing my records and was forcibly impressed with the number of transfusions which I had performed, not as emergency operations, but for the relief of various other conditions. I analyzed the findings and from them formulated for myself this question which I now take as the subject of my paper: "Is transfusion purely and simply an emergency operation? May not its chief field of usefulness be rather as a therapeutic agent, and have we not almost entirely overlooked this possibility?"

True, there will always be emergency cases. There will always be a certain number of cases in which fresh

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blood, immediately and bountifully supplied, will be the only means of saving life. But, are there not a great many so-called medical conditions for whose relief blood, fresh blood, is equally as necessary to life and well-being, though not quite so urgent as in the emergencies? Let me describe the therapeutic potentialities of this procedure.

Let us consider first cases of gastric or duodenal ulcer. Is there a physician who has had a case of this kind under his care in which bleeding has not been a complication? The method of procedure in the presence of the hemorrhage is rest, starvation, ice-bag, morphin, etc., and when the hemorrhage persists, in spite of all treatment, or is so profuse right from its inception as to be alarming, life-endangering, what then is the method of procedure? Starvation, rest, ice-bag, morphin, etc., with a little horse-serum or human serum introduced in order to change the coagulation time of the blood and thus check the hemorrhage. If the bleeding stops, as it does in the vast majority of cases when the blood-pressure becomes so low that the heart is unable to overcome the resistance offered by the vessels, what then is the method of procedure? Is it not that the physician congratulates himself and the family, everybody heaves a sigh of relief and then all sit back, literally with folded hands, patiently to await the gradual, tedious convalescence of the exsanguinated victim, who under our so-called modern conditions must to all intents and purposes work out his own salvation? Furthermore, is it not also a fact that the family is almost invariably told that the enforced rest and starvation diet will be a great boon to the afflicted one in that it will give the ulcer a chance to heal? Thus do we delude others and ourselves. Do these ulcers heal? Do these patients make complete, permanent recoveries? Perhaps a few of them do, but an honest consultation of the records will show that the recoveries are in the sad minority—and the tale told by the record-books can be

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supplemented from the experiences of the surgeon who sees so many of them after they have been cured!

I earnestly believe that in our treatment of such cases we have utterly missed the point. When a person becomes run-down, to use a colloquialism, all our energies are bent toward building him up. No matter what is his ailment, medical or surgical, if the patient is below par, if he is anemic and his hemoglobin is low, attention must be devoted toward raising these most important factors to normal before a complete and lasting cure can be expected. And, correspondingly, with individuals exsanguinated as a result of a gastric or duodenal ulcer, it is unreasonable to expect the ulcer to heal when the body has all it can do to regenerate new blood. Tissues never heal under such conditions. They require nutrition in the form of blood—fresh blood, and quantities of it—in order that they may recover, and I am of the opinion that a proper realization and application of this principle by means of transfusion, in selected cases of course, will result in a much higher percentage of permanent cures than has ever before been obtained. Use transfusion in these cases, not in the active stage of the bleeding, unless it is alarming, but in the quiescent stage a few days after the bleeding has ceased. It is unwise to give too much blood during active bleeding; in the presence of hemorrhage it is hazardous to raise the blood-pressure very much; one should simply give sufficient blood to decrease the coagulation time and tide the patient over this dangerous period. *In the quiescent stage the vessels can be and should be filled to the brim.*

Freshly transfused blood is of service not alone in cases of ulcer of the intestinal canal. Certain forms of obscure anemia, formerly considered intractable, seem, in the light of further experience, to respond with gratifying improvement to transfusion. A little over a year ago I transfused a boy about 7 years old who had suffered for several years from so-called splenic

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anemia. He had had repeated hemorrhages from the stomach and he vomited practically all the blood I gave him about eighteen hours after the transfusion. His hemoglobin then was so low that it failed to register and he was in a desperate condition, so desperate that it was decided as a last resort to transfuse him again and remove his enlarged spleen at the same time. This was done twenty-four hours after the first transfusion, the splenectomy being rapidly performed by Dr. John M. T. Finney. After a very stormy convalescence the boy apparently made a complete recovery. He died five months later from another gastric hemorrhage, probably the result of an old esophageal varix. (After leaving the hospital his mother indulged his fancies and appetite too freely at Atlantic City.) It will be remembered that he had been ill three or four years, during which time these varices had developed.

Only recently I have transfused in a case of anemia of long standing somewhat similar to the above, and the patient is doing so well that her spleen, which it had been planned to remove under a second transfusion after the first one should have improved her condition, has not been disturbed.

Encouraging results are being reported in pernicious anemia, though in this condition repeated transfusion seems necessary. After each operation blood is gradually lost, but repeated doses are apparently beneficial. Not long ago a man was admitted to St. Agnes Hospital, Dr. J. C. Bloodgood's clinic, in desperate straits from pernicious anemia. All medical means had been exhausted, and as a last resort he was transfused. He improved, but shortly afterward lost ground and had to be transfused again. He was given, in all, four doses of blood from three different donors and he lived nearly two years, once getting up to a count of 2½ million red blood-corpuscles and being able to get about a bit. He finally developed a high fever which was fatal. I know of no complete and permanent cure,

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but it must be remembered that transfusion is never done in these cases until all possible medical means have been exhausted, by which time the patient is almost *in extremis*.[1] Perhaps an earlier use might give better results. At any rate, I believe that the evidence against transfusion in these conditions of obscure anemia is based on too few cases and that until the number is great enough to warrant accurate deductions, transfusion, and repeated transfusion, should be practiced in every case in which it would seem to offer the slightest chance of success. By this I mean that the patient should be brought up for operation before he is moribund, before he is in such shape that nothing short of a miracle can save him.[2]

Certain toxemias, obscure in origin, only too often deadly as regards their outcome, may be helped by new blood. A case in point is one that I attended with Drs. Slemons and Burnam—a case of toxemia of pregnancy. The patient was a young woman who had been operated on some months previously for stone in both kidneys. About six weeks before we saw her she had begun to vomit constantly, her urine decreased in amount and she became quite ill, the condition being diagnosed as nephritis. Her course was progressively downward, and finally Dr. Burnam went over to Washington, her home, diagnosed a three months' pregnancy and immediately brought her over to Baltimore, where Dr. Slemons emptied the uterus. By this time the patient was in very bad condition. She had lost about

1. Only ten days ago I transfused a young man who, suffering from a most malignant type of pernicious anemia had a hemoglobin of only 13 per cent. and a red count of a little over 1,000,000 cells. He was benefited for three or four days but succumbed within ten days, as had been prognosticated. The only reason I consented to transfuse this case was that I knew it could do him no harm and because he and his family wished to take the infinitesimal chance of aid that might result. But these cases are *too late*. The patient must come up for transfusion while there is still some fight left in him.

2. So far as I am aware no case of pernicious anemia has been transfused when the hemoglobin was 50 per cent. or over. It might well be that these cases will retain and utilize to advantage, new, whole blood early in the course of the disease, whereas such is not the case later on.

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60 pounds in weight, on account of her vomiting had taken no nourishment for days, and had secreted but 15 c.c. of urine during the preceding twenty-four hours. She failed to respond after her uterus was emptied and about twelve hours later, in an almost hopeless attempt to save her life, she was transfused from another pregnant woman, the theory being that certain antibodies might be present in the blood of one normally pregnant woman which might overcome the toxins circulating in the blood of another woman suffering from the toxemia of pregnancy. We cannot affirm this theory as true, but the fact remains that our patient rallied. Six hours after the transfusion she secreted 75 c.c. of urine and her pulse had dropped from 160 and up to around 120. It was, however, alarmingly irregular. Her mental condition was remarkably clear. She held on in this condition and in the next twenty-four hours secreted 1,100 c.c. of almost perfectly normal urine and seemed on the road to recovery when suddenly about thirty-six hours after the transfusion she died —probably from a myocarditis resulting from the prolonged illness and the overwhelming poison that was apparently eradicated too late to be of service. The ammonia content of this patient's urine before transfusion was 22 per cent. The 1,100 c.c. of urine mentioned above contained 7.8 per cent., the normal being between 5 and 6 per cent. Her urine, therefore, was practically normal in all respects; there was no albumin. Had she not come for transfusion so late, I am sure we could have scored a brilliant victory.

A case very similar to this, but more fortunate in its outcome, has been reported by Dr. H. M. Keator[3] of New York. His patient, also suffering from toxemia of pregnancy, developed in addition a severe purpura. All treatment was unavailing. The uterus was emptied, but the patient failed to rally. She made a prompt and complete recovery after transfusion from her husband.

3. Keator: Am. Jour. Obst., 1912, lxv, 1005.

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I think there can be little question but that transfusion should have a further trial in this distressing and fatal condition, and I would suggest that it should also be tried in those cases of eclampsia that fail to respond to treatment.

Fresh blood has been used with considerable success in pellagra; Cole of Alabama having reported twenty or more cases in which he had done transfusion with 60 to 80 per cent. of cures—a vast improvement over statistics reported by other methods of treatment. I have transfused two patients myself. The first was a woman (St. Agnes Hospital) in the terminal stage of the disease, the mental features being most pronounced. The course of the disease was uninfluenced and she died a few days after the operation. The second, also a woman, was in a stage somewhat earlier than the first, although mental symptoms were becoming apparent. All medical treatment had failed and the patient was going steadily down hill. After transfusion from her husband she made a gradual but apparently complete recovery. She died five months later of acute alcoholism,[4] and at necropsy absolutely no signs of pellagra were found. It is my conviction that transfusion in this condition simply raises the resistance of the patient and enables him successfully to throw off an infection or toxin that would otherwise overwhelm him. It hardly seems likely that there is anything specific.

The success of the foregoing case of pellagra emboldened me to try transfusion in two other cases of skin disease, namely, pemphigus foliaceus and psoriasis. Both were chronic intractable cases and both patients were quite anxious to have the attempt made. Temporary relief followed in each instance; but there was no permanent benefit. Further work in these conditions, especially pemphigus, is in progress and the results will be noted later on. The field is as yet untouched, and it

4. This patient had a decided alcoholic history before she developed pellagra, being especially addicted to gin. After her recovery she began to drink harder than ever with the inevitable result above noted.

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seems not unlikely that whole blood may be of considerable service in certain of these maladies.

Besides the cases in which the patient is suffering from a definite disease, it seems to me that there are many conditions in which and many individuals to whom a supply of good, red blood would seem to be the one thing needed; the boost that would start them off on the up-grade toward health. Cases of chronic infection and consequent debility, cases of lowered resistance resulting from no one definite cause and even certain selected cases of tuberculosis. Think how many individuals there are who are constantly complaining—anemic, sallow, hollow-chested, weak people who never have an appetite and are incapable of work, or who work only under great stress. Iron, arsenic, fresh air, good food—these and a host of other means help a certain number of such patients, but a not inconsiderable number remain to struggle along and eke out a weary, worthless existence. Does it not seem possible that the needed stimulus might come in the form of a bountiful supply of healthy, fresh blood? May it not well be that a number of the undernourished, anemic children or prematurely born babies might be amenable to the same form of treatment?

I might discuss a number of other conditions in which transfusion might be employed—such as hemorrhage in the new-born, bleeding in typhoid, shock, illuminating-gas poisoning, bad surgical risks, etc.—but their mention would serve only to further illuminate a topic which I intended to present not so much for its instructive as for its suggestive value. In conclusion let me emphasize the fact that transfusion, in this day, is by no means the formidable operation it is commonly considered. Judicially used it is practically without risk either to donor or recipient. The dangers of hemolysis and anaphylaxis are practically nil, and a careful examination of the donor—especially is it advisable to have a Wassermann—will rule out the chance of trans-

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mitting disease. I have never known a donor to receive an infection from a recipient. This is, of course, theoretically possible, but is not likely to occur if proper precautions are used to prevent it. In a recent transfusion for hemorrhage in typhoid there was no infection.

Under these circumstances let me ask practitioners to consider the suggestions I have made. Perhaps they will conclude with me that an important therapeutic agent has been almost totally, but not irrevocally overlooked.

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ABSTRACT OF DISCUSSION

DR. HARRY SLOAN, Cleveland: I want to commend Dr. Bernheim's advocating transfusion in cases in which there has been a sudden depletion of blood from the blood-vessels in that it materially reduces convalescence and returns the patient to his normal condition in a shorter time. The principle at fault is the depriving the central nervous system of its normal supply of nourishment. You can see the result of this procedure markedly illustrated in cases of carbon monoxid poisoning, in which there is formed a combination between the hemoglobin and the red cells, and the carbon monoxid, which throws out a greater portion of active hemoglobin-carrying substances. These patients, if left alone, make a very tardy convalescence, three months being usually required before they can return to normal. If the patient is bled and transfused with normal blood, he will make a prompt recovery, and be around again in a day or two. Clinicians tell us that pernicious anemia is usually a fatal disease, no matter what we do for it. There are the ups and downs, the periods of betterment alternating with periods of depression. We have not yet determined the hemolytic factor that causes the destruction of the red cells in pernicious anemia. It has been our experience in filling these people with new blood that they lose it in eight days, and return to the condition they were in before the transfusion. It was simply a temporary measure tiding them over for a few days. The method should not be followed out generally, because it may result in useless operation without effecting the ultimate cure of the patient.

As to transfusion in tuberculous patients: The serum from tuberculous patients hemolyzes the normal red cells. In transfusing a tuberculous patient we run a great danger from active hemolysis occurring at the time of transfusion, with

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the resulting death of the patient, so that in doing transfusion in the case of a patient with active tuberculosis we must be careful that no hemolysis takes place. Clinically, this is shown by a chill during transfusion, tachycardia and dyspnea, without dilatation of the heart. In the cases of tuberculosis in which Dr. Crile transfused with normal blood, the patients seemed to do better than those who did not have the transfusion, but you must shut off the transfusion when the patient begins to complain of pericardial distress with rapidity of the pulse-rate.

DR. B. M. BERNHEIM, Baltimore, Md.: In regard to transfusing in pernicious anemia, we talked with Dr. Sloan yesterday and he said that he did not think it was advisable to do it. I asked him whether he had ever transfused a case early in the course of the disease, and he said no. If you will look up the literature, you will find that no one has transfused a case early in the course of the disease. The patients transfused have been nearly moribund. They were treated by physicians and as a last resort were brought in for transfusion, and it was done as an almost hopeless effort to save the patient. I do not believe that it helps matters much to reason about this matter, and to say that we do not know the cause of the blood destruction. That is true. It seems to me that we might take the case immediately after the diagnosis is made, while the patient has some fight left in him, and while his hemoglobin is still up to fifty or sixty per cent. Instead of giving him arsenic and the usual treatment, which is always fatal, why not try a few cases which might give a different result? As regards instruments for transfusion, Dr. Kimpton's instrument seems to be a good one, but no man can use that tube unless he has worked in the laboratory and has paraffined a tube not only once, but many times. No one else can do it. No one can do transfusions in general unless he has tried beforehand. If a man has worked up his technic on animals and developed it, he can do a successful transfusion by any method. The two things are parallel.

DR. V. C. VAUGHAN, JR., Detroit, Mich.: Some ten months ago I had a case that needed immediate transfusion. The patient was difficult to operate on—a new-born babe. We proved that we could withdraw blood from the donor and by the proper use of saline solution mixed with blood inject it from a hypodermic syringe into the vein of the recipient before it clotted. Dr. Freund of Detroit devised the apparatus. We have two needles, two rubber tubes, going to two-way stop-cock. To this stop-cock is attached a glass tube, with a container for normal saline. One needle is thrust into the vein of the donor, the other into the vein of the recipient.

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We fill the syringe with 1 c.c. of saline solution. Then the stop-cock from the vein of the donor is opened, and we fill the syringe with blood. Then this cock is shut off and the other is opened, and we force blood into the vein of the recipient. That requires no operation, you do not have to cut the skin. We have transfused 150 c.c. without detaching the needles. Anyone can use the method. The blood does not clot.

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CHRONIC FOCAL INFECTION AS A CAUSATIVE FACTOR IN CHRONIC ARTHRITIS *

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CHICAGO

I presented a paper[1] on this subject in January, 1912. The study of the subject has been vigorously carried on since that date. Altogether seventy patients suffering from arthritis deformans have been investigated and treated in the Presbyterian Hospital under the auspices of the Otho S. A. Sprague Institute and the Dane Billings Memorial Fellowship in the Department of Medicine of Rush Medical College.

This clinical research has confirmed the principles announced in the first paper. It has been found that the focal disease was usually located in the head. Most frequently this was a chronic streptococcus focus of the faucial tonsils; but chronic alveolar abscess and chronic sinusitis due to streptococcus infection were an occasional cause. In monarticular osteo-arthritis of the hip especially, chronic hypertrophic prostatitis with residual urine, chronic cystitis and infection with the colon bacillus seemed to be an etiologic factor. There can be no question that chronic gonorrheal infection of the seminal vesicles may cause systemic disease, especially arthritis. Streptococcus infection of the seminal vesicles may also cause systemic infection and especially arthritis deformans.

* From the Otho S. A. Sprague Memorial Institute, the Clinical Department of Rush Medical College and the Presbyterian Hospital, Chicago.

1. Billings, Frank: Chronic Focal Infections and Their Etiologic Relations to Arthritis and Nephritis, Arch. Int. Med., April, 1912, p. 484.

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In this work the chronic focus of infection has been located in the faucial tonsils, dental alveoli or jaw, the antra of the head and in the seminal vesicles and prostate gland.

Rationally one may find the septic focus in any circumscribed streptococcus abscess, possibly a chronic appendicitis, chronic cholecystitis, etc.

The patients who were the subjects of this investigation were from the various walks of life. All were adults. Three patients over 50 years of age suffered from monarticular osteo-arthritis of the hip (morbus coxae senilis). All of the remainder presented the three prevailing types of chronic arthritis with deformities; that is, the so-called proliferative or hypertrophic; the degenerative or atrophic; and the spondylitis deformans type.

The study of these patients shows that an individual who suffers from what may be called a true arthritis deformans presents not only an arthritis (periarthritis, synovitis, osteo-arthritis may be present in different joints of the same patient), but also a chronic myositis which is more or less selective. The muscles most often involved are the biceps humeri, the masseters, the erector spinae, the anterior tibial group and the hamstring muscles. This is a chronic not very painful myositis which causes shortening of the muscular fibers. Hence the inability of most of these patients to extend the forearm fully. Many cannot fully open the mouth because of the contracted masseter muscles. Some rigid spines are due to muscular contraction and rigidity and not to involvement of the joints of the vertebrae.

Most of these patients present evidence of chronic neuritis or perineuritis of single or multiple nerves, at some time in the course of the disease.

Practically all of these patients suffer from general debility; anemia of various degrees, loss of weight, lessened strength and endurance, and functional nervous disorders. Long suffering intensifies the perception of pain and other discomforts.

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There can also be no question that a faulty metabolism modifies the whole morbid process. If one considers the results of the treatment carried out in this investigation, it would seem that the faulty metabolism is not a primary factor etiologically. Nevertheless, it is an important factor in the progress of the disease and also in its treatment.

The severe trophic disturbances which occur in the joints (cartilage, bone, etc.), the appendages of the skin (nails, hair, sweat-glands), are difficult to explain. One does not find cerebrospinal or peripheral nerve lesions to account for these changes as in tabes dorsalis (Charcot joint) or other neuropathic conditions. Probably the primary cause is the tissue reaction to the bacterial toxin, and this specifically excites a proliferative or degenerative local metabolism with the characteristic morbid anatomy. In the experimental inoculation of rabbits with a strain of streptococcus obtained from arthritis patients by Dr. D. J. Davis[2] and Dr. Leila Jackson,[3] non-suppurative, proliferative and degenerative joint lesions were produced. From the joint tissues the same organism was recovered. There is, therefore, a strain of the streptococcus which will specifically produce in the inoculated rabbit morbid anatomic lesions, which resemble the morbid joint changes in arthritis deformans in man.

The method of procedure in this investigation was the same as that described in the former paper. From each patient a most thorough clinical history was obtained. A careful general and special examination was made. When necessary clinical aid was obtained from throat specialists, urologists and other special experts. When found the focal infection was removed surgically or otherwise. Plate-cultures of the material were made from the abscesses or exudate of the operated

2. Davis, David J.: Bacteriologic and Experimental Observations on Focal Infections, Arch. Int. Med., April, 1912, p. 505.
3. Jackson, Leila: Experimental Streptococcal Arthritis in Rabbits, Jour. Infect. Dis., 1913, xii, 364.

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tissues. Subcultures were made from the dominant bacterial colonies of the plates. The opsonic and phagocytic indexes of the blood of the patient with the dominant bacteria were studied before and after autogenous vaccination at intervals of one week. Rabbits were inoculated with the living bacteria, and the results studied on the animal living and dead.

These bacterial studies have revealed some notable results. The dominant organism found in abscesses and sealed crypts of the faucial tonsil are *Streptococcus viridans* and *Streptococcus hemolyticus* (*pyogenes*). The *S. viridans* is usually a surface growth, while the *S. hemolyticus* is frequently found in pure culture in the deeper infected tissues. In acute rheumatism the bacteria obtained from joint exudate and from rheumatic nodes have been studied by Dr. Edward C. Rosenow, fellow of the Memorial Institute for Infectious Diseases, cooperating with us. He has found that organisms from rheumatism appear to occupy a position between *S. viridans* and *S. hemolyticus*. They are more virulent than the former and less virulent than the latter. Three types of organisms have been isolated from rheumatism. One type produces green on blood-agar and forms very long chains. The second type produces a narrow zone of hemolysis on blood-agar from the beginning or after several generations and forms short chains. The third type produces a grayish-brown colony without affecting perceptibly the blood in the media and appears as a diplococcus in short chains and as single cocci. By varying the condition of growth, these types may be changed quite readily, one into the other. The most distinctive cultural features are their production of a very high acid reaction in dextrose broth and abundant growth at a low temperature. They are more virulent to warm-blooded animals than *S. viridans*, but less virulent than *S. hemolyticus* and, of course, the pneumococcus. To frogs at 22 C. (71.6 F.) the virulence of the rheumatism strains is, however, greater than both the *S. hemolyticus* and the pneumococcus; but if the frogs

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are kept at 37 C. (98.6 F.) the order of virulence is the same as in warm-blooded animals.

The cultural features are not so distinctive as the pathogenic properties. The results following injection in animals are quite different from those following injection of *S. viridans, S. hemolyticus* and even mixtures of these two strains. It is common to produce by intravenous injection in rabbits, multiple non-suppurative arthritis, endocarditis, myocarditis and pericarditis in the same animal. By modifying these strains by varying culture methods, their affinity for joints, endocardium and pericardium becomes less and the affinity for the muscles, myocardium and kidney much greater, producing now a non-suppurative myositis. The largest number of these lesions is found in the flat muscles of the neck, shoulders and spine, the intercostal muscles and the more tendinous portions of the muscles of the extremities. Three of the strains from rheumatism have been converted into typical pneumococci. Reverse transmutations may be made from the pneumococcus to the various cultural characteristics (green, gray and hemolysis producing streptococci) by varying the culture mediums, oxygen tension, etc. The strains of streptococci studied from various patients are undoubtedly the same as those described by Poynton and Payne and Beattie as the *Micrococcus rheumaticus*. The results of the clinical studies and animal experimentation by Poynton, Payne, Walker, Beattie, Yates, Cole and others have been of great value in establishing the cause of acute articular rheumatism. Confusion has existed in the minds of many because the organisms described by the different investigators did not coincide.

The results of the work of Rosenow[4] seem to adjust the differences, for his experiments show that the same organisms may be changed by cultural methods so that they may in mediums show progressive phases of trans-

4. Dr. Rosenow will publish the results of his work in the Journal of Infectious Diseases, Chicago, in July, 1913.

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mutation. The range of transmutation is from a type of streptococcus to the pneumococcus. Furthermore, at different stages of the transmutation he has, at will, produced in the inoculated rabbit, suppurative arthritis, or at another phase multiple proliferating arthritis, endocarditis, pericarditis and myocarditis, or at another phase myositis of some of the general skeletal muscles, at another phase, a virulent type which produces arthritis with proliferative and degenerative joint lesions, and at another phase typical pneumonia. These experiments probably clear up this difference in results and the varying types of streptococci described by many investigators.

Many investigators have searched for the source of the infectious organisms of chronic arthritis in the alimentary tract. Strains of streptococci isolated from the feces have been used as vaccines in the treatment of chronic arthritis. We have not experimented with the intestinal flora in this investigation.

In the treatment of these patients we have carried out the following plan:

1. All possible sources of focal infection have been removed. Tonsillectomy; oral surgery for alveolar abscesses (roentgenography will show jaw disease); drainage or other measures to cure sinusitis; vasectomy to drain and to use the vas deferens to wash out infected seminal vesicles and to drain the prostate gland, and any other measures necessary to surely remove all possible streptococcus foci of infection have been made use of.

2. The patient's immunity to the infectious organism has been improved by:

(*a*) Absolute rest for an indefinite period. This may be absolute or partial recumbency dependent on the individual and the character of the disease.

(*b*) Improvement of the general and individual hygiene. The patient needs good air, sunshine, good wholesome food with plenty of proteins to replace

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wasted tissue, restorative tonics when required, plenty of fluid drink and the necessary laxatives. Fatigue must be avoided. Gentle superficial massage may be used, but in the beginning never to the degree of causing pain and fatigue. A cheerful environment and constant moral support is essential to all of these patients who are despondent because of long suffering. Many of them are pessimistic of hopeful results of treatment because baths, superheated air treatments, massage, osteopathy and drugs have not only failed, but have made the disease worse. These measures modified to meet individual peculiarities will usually improve the general condition, and the immunity to the infectious organism is increased as shown by the steady improvement in the condition of the joints. Indeed, it is my opinion that these measures alone will stop the further progress of the disease, and usually entire recovery will take place; but for some patients this will require a long period of treatment.

(*c*) Autogenous vaccinations with the strains of streptococci isolated in each patient. This practice has been followed in practically all of the patients. Immunologic study of the blood has been made coincidently. As a rule the opsonic index and also the phagocytic index have been increased by these vaccines.

Many of the patients investigated had been ill for months or years. Some of them had received vaccinations of commercial vaccines, single and mixed, and during the past year several had received repeated injections of Rheumo-Phylacogen. As far as could be learned, these treatments were instituted without any investigation of the patient's condition, and without a diagnosis of the infectious micro-organism. Not one of them had received benefit from the vaccines of any kind. Many of them were apparently made worse.

There is a value in vaccine therapy, but to obtain benefit from vaccines, they should be rationally used. To use vaccines, simple or mixed, in the treatment of a

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patient, without first ascertaining the nature of the disease, and if infectious, the kind of invading organism, is unscientific, reprehensible and wrong. When the mixed vaccines or the filtrate of culture-broth of countless organisms are used, it is like the shotgun prescription of our ancestors of the profession. They were and are intended to hit something. There is this difference between the old and the new shotgun: The abused stomach could reject the old shotgun mixture; the new shotgun mixture is injected subcutaneously or intravenously, and the patient cannot escape it. It is my opinion that vaccine therapy irrationally used and the injection of so-called serums made from culture-broths is usually without benefit to the patient with arthritis deformans and often results harmfully to the health or life of the invalid.

THE USE OF POLYVALENT STREPTOCOCCUS HORSE-SERUM IN CHRONIC ARTHRITIS

In the latter part of 1911 and the early part of 1912, two horses were immunized with approximately thirty strains of streptococci obtained from the foci of infection of the patients suffering from arthritis deformans. This serum was concentrated and refined and after heating was used in approximately twenty-five patients. The serum seemed to intensify the immunizing effects of the autogenous vaccines. In spite of the practice of all known precautions, every patient suffered after the second or third treatment from anaphylaxis. Usually this was manifested as an erythema and urticaria, with intense itching of the skin. There was usually a slight rise of temperature and much discomfort from muscular soreness, aching and joint pain. Three patients, all women, suffered from anaphylactic shock of such severity that they nearly died. Inasmuch as we could not prevent these reactions, by all known precautions, that part of the treatment was abandoned as a measure too dangerous to use. This we did with the conviction that

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the other measures enumerated before, to improve the immunity of the patient, were practical and sufficient.

When the improvement of the joints and the general condition of the patient permitted, the contracted muscles were stretched under gas anesthesia, and if necessary plaster casts were applied to the lower extremities. At the proper time calisthenics and graduated walking were instituted. Tonic hot-cold spray baths were given daily to some patients.

Hospital treatment is necessary to properly investigate and manage patients with chronic arthritis. Otherwise the necessary discipline, individual hygiene, proper rest and the later application of passive and graduated exercise will not be faithfully carried out.

DIFFERENTIATION OF ARTHRITIS DEFORMANS FROM OTHER TYPES OF CHRONIC ARTHRITIS

Based on these clinical and bacteriologic studies and experiments, I think we may now recognize arthritis deformans as a distinct clinical type. The proliferative and degenerative types of polyarthritis present a subacute or chronic course with exacerbations and remissions, polyarticular arthritis (periarthritis, synovitis, osteo-arthritis), chronic myositis with contractures of muscles and consequent deformities, palpably sore nerve trunks, trophic disturbances of the skin and its appendages, varying degrees of malnutrition and frequently a neurotic condition. Severe and mild degrees of the disease exist. In an early stage recovery may occur and in later stages with serious morbid structural changes the progress may be checked spontaneously. This is explicable when one recalls the fact that the etiologic chronic focus may disappear spontaneously by the development of a process of local immunity.

Chronic gonorrheal arthritis is often deforming and not uncommonly is polyarticular. The knee, ankle, wrist, shoulder and spine are the joints most frequently involved in the order named. Tenosynovitis is a common occurrence in gonorrhea, but myositis practically

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never. Male adults are more often infected than females. The frequency of gonorrhea in female children makes gonorrheal arthritis more common in girls than in boys. If a careful examination is made the focal gonorrhea can usually be found. In the male the seminal vesicles and prostate are the seat of the focus and in the female the vagina, fallopian tubes and probably the glands of the labia may harbor the organism. The skin anaphylactic test may be used to confirm the diagnosis. The removal of the cause; massage of prostate and vesicles, vasectomy to promote drainage of the vesicles and prostate and to permit the injection of antiseptic remedies into the vesicles through the vas deferens, and the necessary surgical and local treatment of the female genitalia will render the diagnosis absolute by the recovery of the patient.

Chronic tuberculous arthritis is usually monarticular, often suppurative, and begins as an osteomyelitis in the short bones or in the epiphysis of a long bone; there is frequently a tenosynovitis and practically never a chronic myositis. The clinical history is usually very characteristic. Often the bone or joint disease immediately follows trauma of some sort. After a period great improvement or apparent recovery occurs to be followed in a few weeks or months by a return of the joint disease, which then steadily progresses in severity.

Neuropathic joints (Charcot) are always associated with some of the characteristic signs of tabes dorsalis.

Chronic podagra, with the characteristic tophi and selection of the small joints as a rule is easily recognized. Gouty tophi may be present as a coincidence in arthritis deformans.

Senile arthritis with deformities due to Heberden's nodes, and atrophic changes may be difficult to differentiate from the degenerative (atrophic) type of arthritis deformans. The absence of chronic myositis, with contraction of the biceps humeri and masseter muscles and the age of the patient are helpful in differentiation. Senile changes may be coincident in arthritis deformans.

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THE RESULT OF THIS METHOD OF TREATMENT

In those patients in whom no marked destruction of tissues has occurred, recovery has taken place in many and others are convalescent. Patients with cartilaginous and bone disease have vastly improved and the progress of the disease has been apparently checked. Case reports are not included for lack of space.

CONCLUSIONS

1. Arthritis deformans is an infectious clinical entity manifesting chronic periarthritis, synovitis, proliferative and degenerative osteo-arthritis, chronic myositis with contraction of muscles and perineuritis or neuritis.

2. Usually coincident but secondary malnutrition and faulty metabolism aggravate the condition of the patient.

3. The infectious source is usually focal and located in the mouth (alveoli), faucial tonsils or antra (sinuses). Occasionally the focus may be in the prostate gland, seminal vesicles, the female genitalia, and probably also in a streptococcus chronic appendicitis or cholecystitis or a circumscribed streptococcus infection anywhere. That the infection may occur from a chronic streptococcus invasion of the intestines is a question to be decided.

4. The morbid anatomy of the experimental chronic arthritis is the same as that found in man. This morbid anatomy is the specific reaction of the infectious organism.

5. Arthritis deformans may be differentiated from other types of chronic arthritis by the characteristic coincident involvement of periarticular and articular structures, chronic myositis, consequent contractions of muscles, secondary trophic changes due to a faulty metabolism, malnutrition, etc.

6. The treatment and management must comprise: 1. The removal of the cause. 2. Improvement of the

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immunity by rest, personal hygiene, including good food, pure air and sunshine, rational calisthenics and physical culture, moral support and a cheerful environment. Autogenous vaccination may be added to still further improve immunity.

7. The clinical results confirm the principles embodies in this paper.

This investigation has been conducted by a group of workers cooperating with me. Dr. Homer K. Nicoll, the Dane Billings Memorial Fellow in Medicine in Rush Medical College, has made the cultures of bacteria and supervised the immunologic vaccinations and serum inoculations. Dr. D. J. Davis, pathologist at St. Luke's Hospital, has supervised the immunologic studies at that institution. Drs. George E. Shambaugh and S. A. Friedberg have performed the necessary nose and throat examinations and operations. Drs. John Ridlon, A. D. Bevan, Dean Lewis, Carl Davis and C. J. Rowan have given aid when surgical measures (stretching muscles, breaking up adhesions, and applying casts and braces) were required in the treatment.

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THE RÔLE OF THE PROSTATE AND SEMINAL VESICLES IN GENERAL TOXEMIAS

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It is now becoming more and more generally recognized that the etiology of many obscure joint, cardiac, neurologic and other diseases is to be found in chronic infections in remote organs, and in recent years the tonsil, nasopharynx, and alimentary tract have come to be regarded as the frequent site of such infections. The extent to which the genito-urinary tract is to blame has not been appreciated, and in reviewing the literature one finds very few valuable articles giving exact data on this question. Of course, it has long been recognized that gonorrhea, both acute and chronic, is responsible for many general infections, but the part played by the acute and chronic infections of the higher genito-urinary tract, the kidney and bladder, the epididymis and testicle, the prostate and seminal vesicles, have received scant accurate attention.

In this article I shall confine my attention to the rôle of the prostate and seminal vesicles in chronic toxemias and remote infections.

The frequency of acute prostatitis and seminal vesiculitis is well recognized. The fact that in the majority of cases of gonorrhea, the posterior urethra, prostate and vesicles become involved is well known, but I believe that the profession fails to realize, or perhaps neglects the fact that chronic prostatitis and seminal vesiculitis are extremely common diseases, and that they may exist without producing symptoms or attracting the attention of the patient for years, only to show themselves as a

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danger-seat when the patient marries or becomes the subject of chronic rheumatism or other forms of remote infection and toxemia arising from an old prostatitis or vesiculitis.

The original etiology of these cases is by no means always gonorrheal. Many arise from bacterial infections which come down through the urinary tract, having been eliminated through the kidneys during acute infections in other parts of the body. I have seen several such cases as a result of typhoid fever, and they are not uncommon in chronic inflammations of the kidney and bladder. Infections also reach the prostate from the rectum not infrequently as a result of proctitis, ulcer, hemorrhoids, etc., but more common still are those which come as a result of the long-continued frequent habit of masturbation, which in many cases produces an extensive chronic inflammatory process involving both the prostate and seminal vesicles and the tissues around them, so that one frequently finds an extensive enlargement and pronounced chronic inflammatory condition associated with local and remote symptoms sometimes of severe character.

The gross pathology of chronic prostatitis and vesiculitis varies so greatly that time precludes my doing more than mentioning the subject here.

On rectal examination often the prostate is very little enlarged, and may be quite smooth, but the surface is generally indurated, often variable in character, slight irregularities being present and adhesions to the rectum and lateral walls of the pelvis usually found. In the majority of cases the seminal vesicles are similarly affected, irregularity, induration and adhesions being the characteristic findings. In more pronounced cases there may be greater enlargement, sometimes very great, very marked induration, and sometimes softening, fluctuation, localized focal abscess, etc., though these are rare. The essential process is an endo-acinous and periacinous inflammation in the prostate and chronic inflammatory

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infiltration within and about the vasa deferentia and seminal vesicles. Owing to the fact that all these structures drain badly, being dependent on minute tortuous ducts and tubules, foci of chronic inflammatory infiltration remain unrelieved for years, often become surrounded by fibrous changes, and remain centers for the absorption of toxins and infections, and sources of local irritation, pain and discomfort.

It is indeed remarkable that any of these patients ever recover. As a matter of fact, in many chronic inflammations in this region recovery never occurs unless vigorous assistance is given either by the mechanical evacuation afforded by prostatic and vesicular massage or hot rectal douches, or by bacterial therapy or by operation.

SYMPTOMS CLASSIFIED

The results symptomatically of chronic prostatitis and seminal vesiculitis may briefly be classed as local, urinary, sexual, nervous and general.

The local symptoms are often so slight (merely a little discomfort, fulness or heaviness in that region) that it is most often the sexual changes which bring the patient for treatment.

The nervous symptoms are often so remote and disconnected that the prostate is not suspected. I have seen many cases of lumbago, sciatica, vague pains in the back, hips, thighs, perineum, groin, and often as far as the soles of the feet, caused by chronic inflammations of the prostate and seminal vesicles which by involving nerve terminals cause stimuli to be sent to the spinal cord and there transmitted to other visceral and superficial regions according to the dicta laid down by Head in his explanation of the etiology of referred pains.

I hope I may be pardoned for digressing somewhat to call attention thus to the great importance of examining the prostate in many painful conditions anywhere between the diaphragm and toes, when there are no localizing symptoms to direct attention to the prostate itself. In such cases it is often the site of an extensive

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chronic inflammatory process which is the cause of the whole trouble. I know of ten cases in which there was operation for renal calculus, the symptoms of which were typical: severe intermittent colicky pain radiating to the groin and associated with symptoms of hematuria and entirely due to a chronic inflammatory process in the prostate and seminal vesicles with reflex referred pains to the kidney region, the blood coming from a congested and inflamed posterior urethra.

It is with the conditions and symptoms resulting from absorption of toxins and bacteria from the prostate and seminal vesicles which it is my particular object to lay stress on, and perhaps I cannot do better than to cite a few cases to bring out some of the different phases of these conditions.

REPORTS OF CASES

CASE 1.—G. W. S., aged 31, complained of multiple arthritis of six years' duration following an old urethritis. There were no local prostatic symptoms. The patient was bedridden and reduced to a skeleton; he was unable to walk, use his hands or even his jaws. He voided urine normally, and there was no urethral discharge, but rectal examination showed that while the prostate itself was only slightly enlarged and indurated, there was an extensive plateau of infiltration above it. An operation through the perineum evacuated a great deal of pus with a resulting immediate benefit in joints which had so long been terribly inflamed.

CASE 2.—R. L. G. complained of arthritis of left knee and painful heels. The patient had had gonorrhea several years before, and now very slight urethral discharge and no urinary symptoms. Examination showed double Achilles tendon bursitis and exostosis of the os calcis, besides extensive arthritis of the left knee. The prostate and seminal vesicles, which gave forth no symptom, were enlarged, indurated and adherent, and the secretion obtained from them contained pus. Treatment by rectal massage and intravesical irrigations of nitrate of silver gave good results.

CASE 3.—M. S. complained of sciatic rheumatism, pain in back, hips and thighs, and inability to walk without crutches. There were no urinary symptoms and no urethral discharge. The urine was clear and the kidneys negative. Roentgenoscopy revealed exostoses along the spine, and examination of the prostate and seminal vesicles disclosed a chronic

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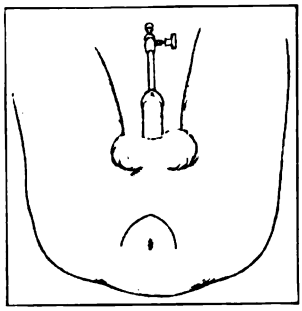

Fig. 1.—Showing the crescentic incision in the skin.

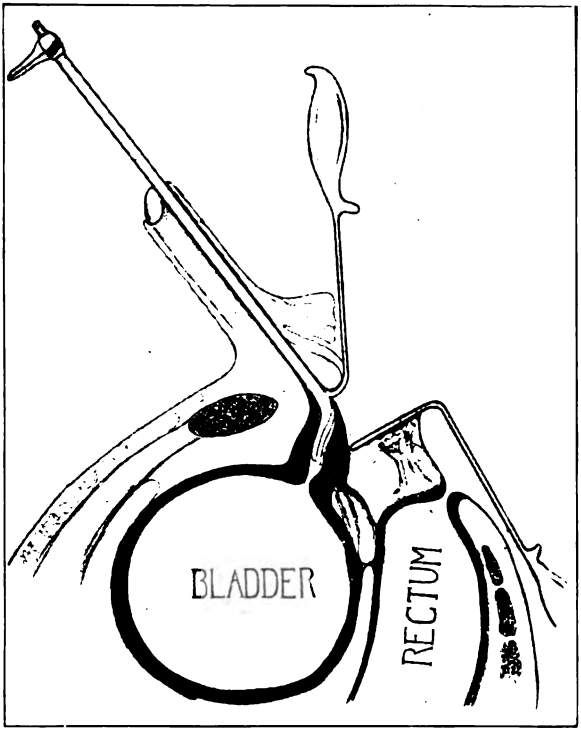

Fig. 2.—The tractor used as a sound in the posterior urethra to show the position of the membranous urethra and apex of the prostate.

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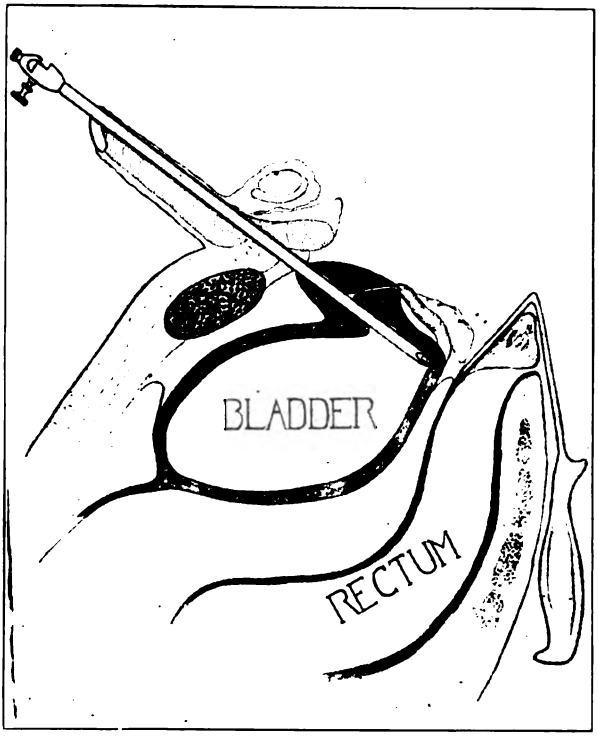

Fig. 3.—Tractor opened out, traction made and seminal vesicles exposed.

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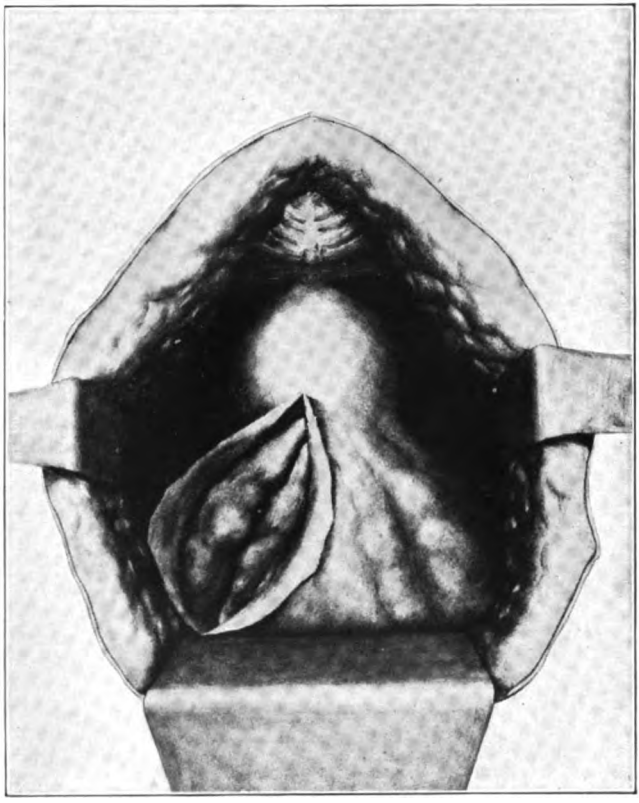

Fig. 4.—Exposure of seminal vesicles. Incision of the fascia of Dénonvillier preparatory to incision or excision of the vesicle.

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inflammatory process, the secretion obtained by massage containing pus in abundance. Under local treatment the patient was soon able to dispense with his crutches and walk, and many of the referred pains had disappeared before plaster jackets were applied for the relief of the spinal exostoses.

CASE 4.—J. B. C. complained of severe dull pain in the right iliac fossa of several years' duration. The patient had had gonorrhea twenty-four years previously and four years later he began to suffer pain which had never left him. The appendix had been removed, the kidneys suspended, various abdominal organs examined and the patient had had numerous operations without relief. Examination disclosed a chronic prostatitis and marked seminal vesiculitis on the right side; the nerve terminals being involved in the inflammation and giving rise to the referred pains from which the patient had suffered so long.

CASE 5.—G. H. R., aged 63, complained of severe pain in the back and legs of ten years' duration, which often incapacitated him from working. There was no history of gonorrhea. There were also frequency of urination and on coughing a severe pain across the lower abdomen. Examination showed a chronic prostatis and vesiculitis with an extremely tender point in the middle of the prostatic urethra, and pressure on this was followed by the escape of a calculus from the urethral meatus.

Endoscopic examination showed a very large verumontanum, in the center of which was a cavity from which the calculus had escaped. The symptoms as described persisted regardless of the escape of the calculus until by treatment the prostate, seminal vesicles and verumontanum had been brought to normal. Since then, for several years, the patient has remained entirely well.

CASE 6.—S. M. C., aged 58, complained of severe attacks of heart-disease, fever and frequency of urination. The patient was quite well until an attack of acute prostatitis, non-gonorrheal in character, several years previously. Since then evidence of myocarditis and severe organic change in the heart has come on, the condition being aggravated from time to time by temporary increase in the prostatic inflammation. Examination showed a very bad heart, myocarditis, auricular fibrillation characterized by severe attacks of dyspnea and very rapid heart-action. The prostate and seminal vesicles were chronically inflamed; infection by the colon bacillus and a chronic cystitis were present. Prostatectomy and seminal vesiculotomy were indicated but not carried out owing to the severity of the cardiac condition. Under local treatment the condition of the patient improved considerably for a time, but in a few months he died as a result of his heart-disease.

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Patients with prostatic hypertrophy have in many instances an associated chronic prostatitis and seminal vesiculitis, and I have frequently seen severe joint troubles and neuritis, resulting from these conditions, absolutely relieved by perineal prostatectomy, often to the amazement of the patient at the unexpected cure of an old rheumatic condition from which he had suffered for years.

Glancing at the literature one finds numerous articles on gonorrheal arthritis and other forms of general gonococcus infection, all of which are too well recognized to need more than passing notice here.

Very little is to be found in the literature in regard to the remote infections and toxemias resulting from chronic disease of the prostate and seminal vesicles.

In a recent report of 254 cases of seminal vesiculotomy performed on account of chronic inflammation of the seminal vesicles, Fuller states that 124 cases, or about 50 per cent., were associated with "absorption or toxic rheumatism," and that all of these cases were relieved in a most radical manner by the operation of vesiculotomy. In his last series of eighty-nine cases, "80 per cent. of the patients were well and free from all symptoms when passed from observation a month or six weeks after operation." One of his patients operated on three years before, after having been on crutches for seven years, is now in perfect physical condition.

Besides the article of Fuller one finds practically nothing in the literature as to the operative treatment of these cases, but numerous rather indefinite articles describing general methods of treatment, particularly by means of vaccines, serums, etc., with some enthusiastic and many unsatisfactory results.

The operation performed by Fuller is so well known that I need not refer to it here. This procedure, which requires such extensive incisions on each side of the buttocks, rectum and perineum and is seemingly so formidable, is shown by Fuller to be free from danger in that he has had no mortality in 254 cases.

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An operation which I have been in the habit of carrying out is based on a desire to see the region of the prostate and seminal vesicles, and to be able to proceed thereon as indicated by the pathologic conditions found to be present.

The prostate is exposed in much the same manner as in perineal prostatectomy, the only difference being that instead of a sound in the urethra a long special prostatic tractor, which can be passed through the urethral meatus is employed. The usual inverted V-shaped cutaneous incision starting with the vertex of the V about 1¼ inches in front of the anus, and the two branches paralleling the ischiopubic ramus to a point about an inch to the outside of the anus on each side are used. After the fat and superficial fascia have been penetrated, the fossa on each side of the central perineal tendon bounded in front by the transversus perinei muscle, posteriorly by the levator ani muscle, and externally by the ischiopubic ramus is opened up by blunt dissection with the finger and scalpel. The bifid tractor is then introduced, thus pulling the levator ani backward and putting the central tendon on stretch. With a scalpel this tendon is divided immediately behind the bulb, and deep down the muscular fibers covering the membranous urethra and known as the recto-urethralis muscle are cut, thus allowing the rectum to be pushed back, and the urethra containing the closed long tractor exposed.

Up to this point the procedure has been practically that of perineal prostatectomy. Now instead of incising the membranous urethra, the long tractor is pushed down into the bladder, opened out, traction made, and the posterior surface of the prostate then exposed after separating the rectum from it, the operator being sure that he is in front of Denonvillier's posterior fascia, and working on the shiny capsule of the prostate itself, which is always the guide to show when one is in the proper layer of cleavage in separating the rectum from the prostate. By continued traction and use at the same

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time of the instrument as a lever by pushing the outer end toward the patient's hip, the prostate is compressed against the triangular ligament and the seminal vesicles are brought up toward the wound where, with good lateral and posterior retraction, any procedure which seems desirable can usually be carried out. Sometimes the adhesions around the seminal vesicles are so extensive that they have to be broken through before good exposure of these structures can be obtained, but usually little difficulty is experienced in drawing the seminal vesicles close into the wound. Examination will then show that they are covered by the same transverse layer of fascia as the prostate, the anterior fascia of Denonvillier which forms the true strong capsule of the prostate and also covers transversely the seminal vesicles, vasa deferentia and intervesicular and retrovesical structures, and this must be divided before any of these structures can be attacked.

It is well here to make a careful survey of the site, to see whether the prostate is sufficiently abnormal in any portion to require incision or excision, and the same for one or both seminal vesicles. The vasa deferentia cannot be so easily detected, but after division of the fascia of Denonvillier they can usually be isolated, examined and opened if desired. Examination previous to operation should have shown with considerable accuracy the conditions present, and given an indication of the extent of the procedure which should be carried out; but the extent of the procedure will depend much on what the operator finds with the parts thoroughly exposed, when they can be palpated and explored. If the seminal vesicle is surrounded by considerable adhesions these should be freed as much as possible, and the vesicle either opened by one or more incisions or by removing a portion of its posterior surface. The fact that the seminal vesicle is a complicated structure running up and down in several loops before finally ending in the ejaculatory ducts shows the importance of a thor-

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ough drainage in several places if necessary, and I occasionally make several windows in the seminal vesicles thus uncovering the interior and supplying good drainage. Resection or incision to a great extent is usually unnecessary and undesirable, except in tuberculosis for which operation is usually contraindicated, though easily carried out by this procedure.

The importance of "pus tubes in the male," as shown by Belfield, suggests that it may be found desirable in some cases to open widely the ampullae of the vasa deferentia which are easily discovered after the fascia which covers them and the vesicles is turned to one side by the two longitudinal or one transverse incision, and I am of the impression that much more satisfactory drainage for chronic collections of pus in the vasa deferentia can be obtained by this operation than through operations on the vasa in the groin or scrotum. The method of attack on the prostate itself depends, as remarked above, on the extent of the pathologic process, incision or excision, single or multiple, with every effort of course to preserve the floor of the urethra and ejaculatory ducts and not to open into the urethra being taken. If the median portion of the prostate is enlarged, indurated and obstructive it may be excised or enucleated from in front of the ejaculatory ducts from one of the lateral incisions in the prostate, but as a rule this is best attacked by the punch operation independently, unless a prostatectomy is desirable, when it will usually be best to employ the regular procedure rather than the method above described.

Fuller advises draining the seminal vesicles for ten days by means of rubber tubes, and his experience has been very extensive. It is certainly important not to remove the tubes or gauze packing too soon, else one is liable to have the external wound close with a recurrence of suppuration in the vesicles and prostate and recrudescence of the rheumatism, etc. The external wound is partly closed by bringing together first the

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levator ani muscles with single suture of chromicized catgut so as to restore them to their normal position in front of the rectum which they protect against pressure on the gauze or drainage tubes, and partial closure of the skin wound. I now generally bring the tubes and gauze out on one side and close the other completely with a continuous subcutaneous catgut suture.

The operation above described is not difficult, in fact much easier than prostatectomy. The long tractor capable of being passed through the urethra does away with the necessity of the incision of the membranous urethra to introduce the old prostatic tractor and thus avoids a urinary fistula, of even temporary character. The ability to see and palpate the prostate, seminal vesicles and vasa deferentia is, I believe, of prime importance in surgery here as elsewhere.

In conclusion, I may say that the prostate and seminal vesicles are very frequently the site of chronic inflammatory processes which often continue for years, give very few local symptoms and are the insidious cause of remote processes, as a result of absorption of toxins and bacteria, and chronic pains referred to other portions of the body, so that the symptoms produced are generally quite remote and apparently unassociated with the prostate and seminal vesicles. This fact should bring home to all practitioners of medicine the very great importance of rectal examinations as a routine procedure. Since such methods have been enforced at the Johns Hopkins Hospital in the medical department, many obscure and distant maladies have been cleared up and ultimately cured by treatment directed to the original source of disease, the prostate and seminal vesicles.

Cold Spring Lane.

ABSTRACT OF DISCUSSION

DR. JOHN RIDLON, Chicago: Is anything to be done for the joint in these cases of chronic non-tuberculous joint disease? What happens if it is not treated? The bone disease usually increases in extent and severity, and finally, after some years, the joint becomes ankylosed; the pain ceases and the patient

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is comfortable for life. If he chooses that, and you agree, well and good. The joint will not then need any mechanical or surgical treatment. If the patient does not choose that course, then you must choose between mechanical and surgical treatment of this joint. If, perchance, the focus of the disease is found and removed and the disease ceases, the joint will recover and be in as good condition as it ever was so far as function and position are concerned. If not, the deformity will go on, and it is the function of the orthopedist or the general surgeon to prevent the development of the deformity and lessen the pain. These chronic joint inflammations should be treated in the same way as a chronic tuberculous joint is treated, by immobilization and more or less protection for a certain period. So long as there is a tendency to the development of deformity, the joint should be held in the position for greatest comfort and best function and kept immobilized for months or even years. When the patient can stand without pain or discomfort in his immobilization apparatus and when much of the swelling and irritation found locally have disappeared, then I am accustomed to relieve the patient of his immobilization and test out the condition of his joint. Experience is the only guide in choosing the time for this, but there is no need of worrying too much about immobilizing these cases, even if they become ankylosed, because they will become ankylosed whether they are immobilized or not. The point to be remembered is that if the ankylosis occurs, the joint should be in the best possible position. If there is a deformity it can best be corrected at one sitting by force, anesthetizing the patient and then immobilizing the joint until all the soreness resulting from the manipulations has passed. In the case of the hip, the leg should be in slight flexion and the shortening which usually results from destruction of a hip-joint is compensated by a certain degree of abduction. The spine should be straight. The knee should be slightly flexed. In the case of the spine, it should be straightened out and held until it stays in position of itself. This should be done at once, or by repeated applications of force and plaster of Paris, forcing while the plaster is setting.

I do not think that such patients should be operated on. The point is, however, that the patient should know that he is the one to choose. He should also know that he may have a good result without an operation.

Dr. Bransford Lewis, St. Louis: In my own experience the posterior urethra is infected in over 90 per cent. of all urethral gonorrheal infections. Of late infections of this kind have been better controlled by the less irritating silver solutions, such as argyrol, nucleinate of silver, and so on; but at the same time, we cannot fail to observe the enormous frequency with which these parts of the tract are infected.

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Another phase of material importance is the fact that the infection is often not of venereal origin, and therefore apt to be overlooked by one who is not particularly searching in his examination. Even if a patient of this class pass all his urine into two glasses and both are clear, pus that comes from the seminal vesicles may fail to be observed. If you let the patient pass two glasses of clear urine, then massage the prostate and after this have him urinate again, and then find the urine cloudy, containing enormous numbers of pus-cells and possibly numerous gonococci or other microbes, you can determine with certainty as to whether he has seminal vesiculitis.

Another point of importance is that in doing the massage of the prostate the patient should be told to place a little butter-platter under the meatus and catch whatever passes out from the urethra. This is subjected to the several steps of examination. By means of massage and heat, irrigations and the use of vaccines we can control these cases better than we used to when we did not have these methods of treatment. In the absence of success with these the operative method is resorted to, and I have used the one described by Dr. Young and found it entirely satisfactory. If only one point is remembered in connection with this subject, it should be that we must detect the focus of infection, which may have persisted for one, ten or fifteen years. By doing so it is possible to clear up a case in which the patient has been a sufferer from a disease which has been beyond the reach of ordinary surgical measures.

DR. D. N. EISENDRATH, Chicago: Not enough emphasis has been laid on the kidney in this symposium. There are so many cases which reach the general practitioner in which there is absolutely no localizing sign pointing to the kidney as the source of the infection. These cases may run along, sometimes for weeks or even months, with a temperature of from 99 to 104 F. and with no evidences of toxemia in the joints, but rather in the body in general. These are the cases that puzzle so many of us, and they are the cases that are so frequently treated and called, for lack of a better name, low typhoid, chronic malaria and cryptogenetic infection. Especially are these the cases in which the patient has been observed for a long time, with low-grade toxic symptoms, and then suddenly the fire flares up, the patient has a temperature of 103 and 104, but still there is no sign of kidney disturbance. Therefore, if we will only consider the kidney—in fact, the urinary tract—in making the differential diagnosis, we shall often clear up a mysterious case, and be able to benefit the patient. It is only by a process of exclusion, by examining the urine carefully, that we can make a correct diagnosis in many cases of chronic joint infections.

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ADMINISTRATION OF ALKALOIDS BEFORE ANESTHESIA

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In the older records in medical literature there is abundance of evidence that many of the drugs which are employed to-day and which we are prone to consider recent discoveries were used by the ancients for the relief of pain during surgical and other procedures. They made decoctions from the leaves, bark and roots of plants and trees, which they drank, inhaled the fumes of or applied locally. In order to produce sufficient insensibility for operative measures very large doses had to be given. As a result patients frequently remained unconscious for hours or slept on to death. When the anesthetic properties of nitrous oxid, ether and chloroform were discovered, these agents rapidly replaced the drugs employed at that time, but it was generally thought necessary or expedient to reinforce them with drugs possessing hypnotic virtues. Morton, for example, gave large doses of opium before administering ether. As the action of anesthetic substances and the technic of their administration became better understood, the practice was quite generally abandoned. In 1900 Schmeiderin directed attention to the advantages of administering morphin and scopolamin alone or before inhalation anesthesia, and reported the results of this method in ten instances. The sedative and hypnotic effects of scopolamin on the insane is well known and Schmeiderin, an alienist, found that the insane could be more easily

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managed if given morphin and scopolamin prior to general anesthesia.

The administration of sedative drugs before anesthesia is of great importance and may be considererd from at least three points of view, namely, the patient's, the anesthetist's and the surgeon's. The three alkaloids most commonly employed are morphin, scopolamin and atropin. Before the physiologic action of scopolamin was well understood, Schmeiderin maintained that its action was antagonistic to that of morphin, and, unfortunately, his statements have been rather widely accepted. Hyoscin and scopolamin are now universally recognized by pharmacologists as identical chemically and physiologically. Therefore, the two names will be used interchangeably. Scopolamin and atropin are closely allied alkaloids belonging to the deadly nightshade family. The difference in the structural arrangement of the molecules composing them is believed to explain differences in their action. In order to facilitate a comparative study I have indicated in the accompanying table the actions of morphin, scopolamin and atropin in so far as they are concerned with the subject at hand.

That there are certain advantages in preliminary medication no one of experience will question, but the disadvantages must not be lost sight of. As the comparative safety of ether and chloroform has been settled through a clear understanding of their physiologic action, immediate and remote, so must the advantages and disadvantages of sequence, mixed anesthesias and preliminary medication be settled through a knowledge of the action of the drugs singly and in combination. It is well known that one drug frequently intensifies the action of another and this is especially true of those drugs whose actions are similar. The advantages said to accompany the administration of alkaloids before general anesthesia are as follows:

1. Less of the anesthetic is required. Glandular activity is diminished, thereby reducing the danger of pneu-

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TABLE 1.—THE ACTION OF MORPHIN, SCOPOLAMIN AND ATROPIN

	Morphin*	$C_{17}H_{21}NO_4$, Scopolamin	$C_{17}H_{23}NO_3$, Atropin
Respiration	"Is a powerful depressant to the respiratory center." "The characteristic effect is to lessen its activity, diminishing the rate and depth of respiration."	"Hyoscin is not in any dose a respiratory stimulant and in large doses it is actively depressant to this function."	"Moderate doses stimulate respiration, large doses depress it."
Circulation	"Exerts no direct action on the heart which continues to beat after respiration ceases." "Dilates the vessels of the skin leading to a flushing of the surface, especially the face."	"Small doses raise blood-pressure. Pulse is not ordinarily influenced."	"Increases blood-pressure and greatly accelerates pulse."
Nervous System	"Action is entirely central. Toxic doses produce paralysis of the respiratory center in the medulla."	"Generally depresses the brain producing sleep, but possesses little or no analgesic effects." "Occasionally produces restlessness with hallucinations and delirium."	"Large doses cause restlessness and excitement."
Pupils	"Contracted pupils."	"Dilates the pupil when administered internally or applied locally."	"Pupils dilate on internal administration or local application."
Glandular Activity	"Glandular secretion is less active unless nausea is produced when there is an increase of saliva and perspiration."	"Less glandular activity produces dryness of the mouth, throat and bronchi."	"Diminishes or completely arrests secretion."
Kidneys	"Depresses kidney function."	"Depresses kidney function."	"Depresses kidney function."

*Wood, H. C., Jr.: Pharmacology and Therapeutics, 1912. Stevens: Materia Medica and Therapeutics, 1909. Withaus and Becker: Medical Jurisprudence, Forensic Medicine and Toxicology, iv.

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monia. There is less vomiting before and during anesthesia, therefore a smoother narcosis and also less post-operative vomiting.

2. The patient's apprehension of impending danger is lessened or altogether abolished and he enters the anesthetizing room in a quiet, sleepy manner. No resistance is made to preliminary preparation.

3. The stage of excitement is less pronounced and muscular relaxation is more quickly developed.

4. The patient remains asleep after completion of operation, hence suffers less pain. Let us analyze these advantages.

LESS OF THE ANESTHETIC IS REQUIRED

The lessened amount of the anesthetic required is not so important as is generally supposed. It has been conclusively shown experimentally that the degree of concentration of the vapor is of much greater importance than the length of the administration or the amount used. A very concentrated vapor used for a few minutes will do more damage to lung and kidney epithelium than a lesser concentration over a long period. The amount used is always relative. An experienced anesthetist uses much less than a novice. In considering the lessened amount of the anesthetic used the action of the substance which replaces it must be taken into account. That the danger from ether or chloroform is diminished has certainly not been proved. On the contrary, a study of the reports of deaths or other bad results clearly shows that the premedication was actually responsible either indirectly by intensifying the action of the anesthetic or directly through its continued action. There are always symptoms from ether and generally from chloroform which give adequate warning of approaching danger, and both are so evanescent in their action that the patient revives in a comparatively short time when they are discontinued; but, when enduring drugs or combinations of drugs have been previously administered, hours may

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elapse before the patient is past danger. A review of the literature shows that practically all of the reported deaths were caused by respiratory failure often accompanied by cyanosis and Cheyne-Stokes' respiration, suggesting a paralysis of the centers in the medulla. The conservative surgeon and anesthetist, although they may have seen no deaths or alarming respiratory depressions, should not pass lightly over the experience of others, but should instead weigh seriously the advantages and disadvantages of a procedure which carries with it additional risk to the patient. Scientific men cannot fail to appreciate the reasonableness of maintaining a factor of safety by protecting the respiratory center and by exercising all possible care in the technic of anesthetization.

GLANDULAR ACTIVITY IS DIMINISHED THEREBY REDUCING THE DANGER OF PNEUMONIA

Many of the postoperative pneumonias have nothing whatever to do with the anesthetic but are embolic in their origin and occur quite as frequently after local analgesia as after general anesthesia. A pneumonia which develops later than thirty-six hours after anesthesia should not be considered as due to the local action of the inhaled ether. Since the open method of etherization has become so universally employed, the tendency to postoperative pneumonia and nephritis has been materially lessened.

If the head is turned to the side as soon as the neck-muscles are sufficiently relaxed to allow it, and this can be done early in induction, the salivary secretion will escape at the angle of the mouth or remain in the cheek where it can be sponged out. This position has the further advantage of preventing the tongue from falling back in the pharynx and obstructing respiration. That the aspiration of mucus ever produces pneumonia is a doubtful possibility. If ether actually predisposes to pneumonia it does so by its direct action on the lung epithelium, and it is just as reasonable to presume that

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the checked secretion would render the unprotected cells more susceptible to irritation. Only rarely does the bronchial secretion become sufficient to interfere with blood oxygenation and when it does, the anesthetic may be withdrawn at a time when operative procedures will not be interrupted or interfered with; the mucus acting as a foreign substance will cause coughing when the patient is still asleep and the bronchi will be cleared by a few efforts. The anesthetic can then be continued. This seldom needs to be repeated. Because of the checked glandular secretions, patients frequently complain of great discomfort before and after anesthesia caused by the dryness of the mouth and throat at a time when water is denied them. Patients should be well protected during artificial sleep to prevent as far as possible loss of body heat. A similar statement applies during conveyance from operating-rooms through draughty halls and elevator shafts when resistance is low.

LESS VOMITING BEFORE AND DURING ANESTHESIA; THEREFORE A SMOOTHER NARCOSIS AND ALSO LESS POSTOPERATIVE VOMITING

There will be no vomiting during the induction of narcosis if the patient has been properly prepared. Vomiting during anesthesia always indicates a light uneven narcosis; in other words, with proper technic an absolutely smooth anesthesia is obtained without preliminary medication. The degree of narcosis must fit the operation and the character of the tissues being dealt with. The physician anesthetist, being familiar with the operative procedures, will anticipate the steps of the operation by keeping in touch with the operator and will produce a deeper narcosis when indicated. For example, after the clamps are placed in stomach and intestinal work only sufficient anesthetic is required to prevent vomiting, as there is little sensation in those structures. This is also true in thyroidectomies after the skin incision; little anesthetic is necessary until the skin sutures are

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being placed; then a deeper narcosis is essential lest the patient move and interfere with this step of the operation. That postoperative nausea and emesis are lessened is questionable. That vomiting may be delayed is quite understandable from the continued action of the morphin and scopolamin. Patients feel nauseated or begin to vomit several hours after their return to bed or at a time when they should and probably would be over it if the nausea were due to the anesthetic.

THE PATIENT'S APPREHENSION OF IMPENDING DANGER IS LESSENED OR ALTOGETHER ABOLISHED AND HE ENTERS THE ANESTHETIZING ROOM IN A QUIET, SLEEPY MANNER

In lieu of the stupefying effects of morphin and scopolamin for producing a peaceful mental state we propose cheerful kindness, tactful sympathy, suggestions as to hoped for improvement or restoration to health, all of which will do much toward quieting a nervous patient. Excitement and haste should never be apparent; likewise, joking or other forms of hilarity in the anesthetizing room frequently impresses the nervous patient with fear that he is not receiving the close attention that the situation demands. A calm, courteous, masterful personality is a desirable requisite in an anesthetist as it does much toward inspiring confidence, and with confidence comes a sense of security and quiet. Final preparation of the field of operation during induction of narcosis not only shortens the anesthesia but helps to divert the patient's mind from the anesthetic.

THE STAGE OF EXCITEMENT IS LESS PRONOUNCED AND MUSCULAR RELAXATION IS MORE QUICKLY DEVELOPED

When the technic of the induction stage is properly carried out the so-called "stage of excitement" is either absent or so slight as to be scarcely noticeable except in alcoholics. If patients of the latter class are arranged on the table with restraint straps so that they can be

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controlled, stimulation passes off in a few minutes. The development of muscular relaxation is only a matter of a little more time.

THE PATIENT REMAINS ASLEEP AFTER COMPLETION OF OPERATION, THEREBY LESSENING PAIN

If an opiate is required for the relief of pain it can be administered when the patient is sufficiently awake to complain. Then one can be guided by conditions as to indications and contra-indications for its administration. Following nitrous oxid, it can be given at the completion of the operation while the patient is still on the operating-table.

Disadvantages of preliminary medication to general anesthesia may be summarized as follows: 1. Danger of respiratory paralysis. 2. Destruction of pupillary reaction. 3. Varying effects of the drugs. 4. Necessity of having a trained, experienced anesthetist in charge of the administration. 5. Predisposition to pneumonia in mouth, jaw and throat operations. Necessity for constant attendance until awake. After-effects as vomiting, headache and a blocking up of secretions. Prolonged respiratory depression which may favor pulmonary edema.

Let us now consider these disadvantages.

DANGER OF RESPIRATORY PARALYSIS

When machines are designed calculations are made to determine the points on which greatest stress will fall and an effort is made to strengthen or fortify these points, in order to provide for contingencies that may arise. In the case of anesthesia the respiratory center is the specially vulnerable point, and every hypnotic drug administered increases the burden which it is called on to bear; therefore, when we employ narcotic drugs before general anesthesia we display poorer judgment in our anesthetic technic than does the designer of machines. "Any dose of morphin that produces systemic effects depresses respiration. Hyoscin is not in

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any dose a respiratory stimulant and in large doses is actively depressant to this function" (Wood). The combined action of these two drugs is much greater than the sum of their separate action. In other words it is an example of the well-known therapeutic observation that one drug may intensify or augment the action of another, and this is especially true in a scopolamin, morphin, ether or chloroform combination. A much smaller quantity of chloroform or ether will paralyze the respiratory center if it is already depressed by morphin and scopolamin, and therein lies the danger.

Comparatively speaking, a patient may be fairly safe if an experienced anesthetist is in charge, but the method is especially dangerous if an untrained, inexperienced person is administering the anesthetic, as he may fail to recognize approaching respiratory failure and continue the anesthetic until breathing actually ceases. A review of the literature indicates that such respiratory failure frequently proves fatal, in spite of all efforts at resuscitation.

DESTRUCTION OF PUPILLARY REACTION

I unhesitatingly place next in importance to respiratory depression the destruction of the pupillary reaction. To one who is capable of interpreting properly this reflex, it is of the utmost value. There is nothing else which will denote so absolutely the degree of narcosis, or give more certain warning of approaching danger or indicate it more clearly when it is already present. Eyelid, pharyngeal and corneal reflexes when present simply denote a light anesthesia.[1] The amount of relaxation in the muscles of the neck and jaw, especially the latter, is of considerable value but not always reliable. A change in respiration and circulation occurs just before vomiting takes place and is so similar to the change when too deep a narcosis is present that without the aid of the

1. The touching of the cornea is absolutely unpardonable and is as unscientific as it is unclean. Serious eye-infections frequently follow such uncalled-for practices.

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pupil it is frequently difficult or impossible to tell which it is. The modus operandi called for being different in the two conditions, it is essential to be able to distinguish between them.

VARYING EFFECTS OF THE DRUGS

Because of the varying effects of scopolamin its purity was at first questioned but it is now well known that equal doses taken from the same specimen affect different people variously, or the same person is variously affected at different times. On account of such idiosyncrasies it has been suggested that patients be given trial doses on the day preceding the operation. It is also a wise precaution to inquire regarding the effect of morphin as not infrequently patients know of unusual reactions they are likely to exhibit toward this drug.

SHOULD BE USED ONLY WHEN A TRAINED, EXPERIENCED ANESTHETIST IS IN CHARGE

It is often maintained that untrained persons should not administer anesthetics, to which I most heartily agree, but inasmuch as this is frequently done, the patient should be safeguarded in every possible way. The surgeon may be delayed a few minutes before muscular relaxation develops without preliminary medication, but it may be time or a life saved in the end. If respiratory failure develops when only ether or chloroform has been used, automatic respiration continues when once established, because the introduced poisons are quickly dissipated. But not so when drugs whose actions continue for some time, as morphin and scopolamin, have been administered.

PREDISPOSES TO PNEUMONIA IN OPERATIONS OF MOUTH, JAW AND THROAT

In operations of the mouth, jaw and throat an early awakening is most desirable. Morphin allays the reflex excitability of the air-passages, thus retarding coughing and favoring the retention of aspirated blood or vomitus

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in the trachea and bronchi, a condition which predisposes to pneumonia. Many people are unable to take morphin even in moderate doses without distress and vomiting and in such patients the disagreeable after-effects of ether or chloroform would be aggravated. On account of the respiratory failure which may develop after the patient has been returned to bed, constant attendance is necessary for several hours. By checking sweating, it throws a greater strain on the kidneys whose function is already depressed. Allow me to cite from my own experience.

A young woman was given 1/4 grain morphin and 1/150 grain scopolamin followed by a forty-five-minute ether anesthesia, during which time a laparotomy was performed for some pelvic trouble. The patient was returned to bed in fair condition. Nearly two hours later respiratory failure developed and she was revived by artificial respiration. About an hour later respiration again failed and artificial respiration was required a second time after which, although the respiration was shallow for a time, it regained its normal depth and frequency.

A similar experience was furnished by a robust man in middle life who was being operated on for fracture of the inferior maxilla.

The patient had been given 1/6 grain morphin and 1/100 grain atropin. The anesthetist was a trained, careful, observing man who assured me he had given a very small amount of ether. Respiration failed early in the operation and was with difficulty reestablished. The operation was continued and, when the patient complained, ether was given but respiration soon failed again. I was called from an adjoining room and we succeeded in establishing automatic respiration after some time and much anxiety. The operation was completed without further anesthetic. Although respiration was superficial and slow it did not cease again, but it was three hours before consciousness returned. There can be no possible doubt as to the cause of respiratory failure in either of these cases, for if it had been due to the ether, automatic breathing would have continued when once established by artificial means as there was no obstruction to the entry or exit of air.

Another experience, unfortunately, did not terminate so favorably.

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A woman, aged 36, suffering with exophthalmic goiter was given 1/6 grain morphin. An hour later a light ether narcosis was produced and the right superior thyroid vessels ligated and the left vessels exposed ready for ligation, when respiration, which had been shallow, ceased. All effort at resuscitation proved futile.

It is true that the woman was an exceedingly "bad surgical risk" but I am satisfied that I have anesthetized many equally bad with no adverse results. There have been several other instances in my work in which alarming depressions or Cheyne-Stokes' respiration occurred without the development of paralysis which was probably due to an early withdrawal of the anesthetic. A familiarity with the literature shows me that my experience is in no way unique, as there are many reports, not only of temporary respiratory failures, but of deaths during narcosis and after patients have been returned to bed. Persons who were formerly enthusiastic supporters of the practice of administering alkaloids before general anesthesia have either abandoned it entirely or use it only in selected cases and give very small doses. Standing orders for the same fixed dose for every patient without regard for age, condition or operation are certainly not to be recommended.

The selection and administration of anesthetics should be placed on the same sound, scientific basis as asepsis or the practice of surgery. Competent anesthetists, like competent surgeons, are not agreed on all subjects, but we are coming to a better understanding of the physiology of anesthesia, and now that this very important branch of medicine is receiving a much-needed review, we may hope for better anesthetists and better anesthesias. I trust the time is not far distant when the study of anesthetics will be made an obligatory part of the curriculum of every medical college. Surgeons who work with regularly qualified anesthetists should consult with them regarding the selection of the anesthetic and the best method of administration, espepecially in the so-called "surgical risks." As the anes-

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thetist is responsible for that part of the work, he should be allowed the privilege of giving or withholding alkaloids before anesthesia. The surgeon may be likened to the captain, the anesthetist to the pilot and the patient to the ship. The captain must of necessity depend on the pilot to steer the ship into and through the darkness of oblivion back to the light of consciousness. It is the pilot who, seeing the shoals and sandbars and realizing how near they are to disaster, questions the chosen course. The experienced pilot is much better able to cope with the situation than the inexperienced and yet he, too, although seeing danger ahead, may not be able to escape because the undercurrent, which is the method of anesthesia employed, is beyond his control.

INDICATIONS AND CONTRA-INDICATIONS

Indication: Local analgesia.

Contra-indications: Morphin and scopolamin are contra-indicated, in the case of patients in whom the respiratory center is depressed or likely to become depressed through operative procedures, obstructive dyspnea due to growth within or without the trachea causing pressure, or exophthalmic goiter; in operations about the mouth or throat; in the case of debilitated and cachectic persons or those suffering with continued sepsis; in patients presenting any degree of stupor or those susceptible to morphin, in children and elderly people, and when untrained, inexperienced anesthetists are administering the anesthetic.

CONCLUSION

1. The administration of morphin, scopolamin and atropin before general anesthesia has certain advantages but these advantages are not sufficient to counterbalance the risks attendant on their employment.

2. The loss of the pupillary reflex is a serious handicap, as nothing else indicates so unerringly the degree of narcosis.

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3. That the danger from ether, chloroform or nitrous oxid is diminished is contrary to the evidence at hand.

4. They should not be employed when untrained, inexperienced anesthetists are in charge, as the anesthetic is rendered more complicated and extra skill and judgment are required.

5. The routine use of certain fixed doses before every anesthetic regardless of the patient's condition should be discouraged.

6. The employment of alkaloids has a distinct field of usefulness before local analgesia.

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NITROUS OXID AND OXYGEN ANESTHESIA

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Dr. Teter, Miss Hodgins and Miss Toot of Cleveland and Dr. McKesson of Toledo have administered nitrous oxid for surgical purposes over twenty thousand times without a death from anesthesia.

In the hands of the expert nitrous oxid is perhaps the safest known anesthetic, while it is perhaps the least safe in the hands of the inexpert. In equally expert hands ether may rival nitrous oxid as to immediate mortality, but ether is wholly outclassed by nitrous oxid as to the indirect postoperative morbidity and mortality. This striking difference is wholly beyond the control of the anesthetist because it rests on a chemical basis. The chemical reactions which favor nitrous oxid anesthesia and handicap ether anesthesia are the following: Nitrous oxid produces anesthesia by reason of its interference with the use of oxygen by the brain-cells; it apparently exerts no other influence except this oxygen interference; therefore its total effect on the body contines but a few minutes beyond the termination of its administration.

Ether, on the other hand, produces anesthesia by dissolving the lipoids of the brain; in addition, unfortunately, ether dissolves many other important lipoids in vitally important structures, such as the lecithin in the red corpuscles—it even breaks up this important structure, as is evidenced by the appearance of hemoglobin in urine, and by a postanesthetic anemia; ether also dissolves the specialized fats in the kidney, the liver and

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other organs, and, perhaps most unfortunate of all, the lipoids in the phagocytes. Hence it is that ether puts to sleep not only the patient but also the host of defenders, the phagocytes. The result of this is seen in the strikingly adverse effect sometimes following ether anesthesia in the presence of acute infections. These adverse ether effects are especially striking when compared with the effects of nitrous oxid.

Lung complications following nitrous oxid anesthesia are no more frequent than they are in normal persons who have received no anesthetic. I have never known a fatal postanesthetic pneumonia following nitrous oxid. Nitrous oxid plays a passive rôle so far as causing or increasing an existing nephritis is concerned, so that we no longer see postoperative suppression in elderly subjects following anesthesia. As a general anesthetic for diabetics, nitrous oxid is without question the anesthetic of choice. These patients apparently take it with no harmful results whatever, and up to the present I have neither seen nor heard of any deleterious effects following its administration for seventeen amputations in diabetic gangrene.

In comparing ether with nitrous-oxid anesthesia we may say that the dangers and difficulties of nitrous-oxid administration are technical and controllable, while those of ether are inherently chemical and uncontrollable. What, then, are the principal points in the technical control of nitrous oxid? First of all, the induction of anesthesia should be so gradual and careful that never for a moment is there cyanosis and never any muscular twitching on the way to complete unconsciousness. Nor is this all. After superficial unconsciousness is reached, the finesse is continued until regular rhythmic respirations are established and the stage of surgical anesthesia for nitrous oxid is reached.

This is not so deep as that for ether. The patient will "feel" the surgeon's instruments far more readily than under ether, which is a great advantage to the cautious

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surgeon as it warns him against needless roughness. Under certain circumstances nitrous oxid should be supplemented by ether, for instance, in the case of topers, patients under high nervous tension, and certain abdominal operations in which mass-traction in dislodging tumors must be made; under these or any other circumstances, pink nitrous-oxid anesthesia, if not adequate, is supplemented by ether. I am not an advocate of nitrous oxid alone, or of ether alone, but of good anesthesia.

Muscle tone is not so completely abolished as under chloroform or ether, because under nitrous oxid, surgical anesthesia is much nearer consciousness. Patients who go to the operating-room in fear show this much more markedly than do tranquil patients; in other words, the former are fighting subconsciously during the anesthesia. In order to overcome this factor by dulling their keener perceptions and rendering them oblivious to their surroundings, patients, excepting the very young, the old and the feeble, are given preliminary hypodermic injections of morphin and scopolamin from one and a half to two hours before being taken to the operating-room, so that by this means a large percentage of them retain no unpleasant memory of either going to or coming from the operating-room.

Muscle rigidity under nitrous oxid was formerly a handicap. Crile has now solved this problem so completely that, by following his method it is necessary to use abdominal tapes to hold the viscera out of the operative field in exceptional cases only.

The first factor in obtaining complete relaxation is to have the patient brought to the operating-room in a neutral state mentally, so far as any fear of the operative procedure is concerned. This is accomplished by the preliminary hypodermic. Then the muscular system lacks the tone that we see in preparation for a fight or flight with the accompanying fear. Having no mental anxiety, the patient falls to sleep under nitrous oxid as naturally as though at home in bed. Compare with

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their condition the state of the patient who is brought to the operating-room in mortal fear. Even when unconscious every muscle is tense, pupils are dilated, respiration is increased and labored, and pulse-rate accelerated. This state is prone to continue during the whole anesthesia.

The second factor in muscle rigidity is tissue-trauma during the operation. Every surgeon has seen muscles increase in tone and contract while they are being cut, and has noted how a lightly anesthetized patient strains while he is attempting to pack off the intestines. When the abdominal wall is being cut through the same reflex is involved as when one is expecting an abdominal blow and hardens his muscles as a protective measure. This persists, even while the patient is unconscious, as a reflex reaction to trauma. This factor is present under any general anesthetic up to that point at which muscle-tone is abolished by the depth of anesthesia. The factor of tissue-trauma may be disposed of by blocking the entire operative field with 1:400 novocain solution. The block, however, must be absolute, for if any impulses get through, the muscles at once increase in tone with the resulting rigidity. Technically this procedure demands considerable practice before the operator is able to open an abdomen and keep it flaccid like the open abdomen of a recent cadaver.

This practice of locally blocking the operative field is far-reaching in its influence. When one is manipulating an unblocked sensitive tissue, the immediate change in respiration and the restlessness of the lightly anesthetized patient teach him manual gentleness and precision, so that he comes ultimately to work as it were with "the velvet hand." This gentleness in turn permits the more kindly healing of wounds because there is less tissue-repair necessary. At the same time the patient's postoperative discomfort is lessened so much that the majority of patients are surprised at their ease and the shortened period of convalescence. Then in addi-

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tion manual gentleness creates a feeling of sympathy between operator and anesthetist so that they come to play into each other's hands for the mutual benefit of the patient—the surgeon realizes that not a few anesthetic difficulties have their origin in the manipulations and so gives the anesthetist time to deepen the narcosis before completing his own procedure.

Only from one-half to two-thirds the usual amount of inhalation anesthetic is needed when the operation is done under complete anoci-association.

Nitrous oxid meets a need that no other form of narcosis meets: the patients who are most gravely ill take it best and are not in the least harmed by the procedure. Patients experience none of the disagreeable smothering sensation associated with the inhalation of ether vapor, but have merely the feeling of sailing away through the air and notice no disagreeable taste or smell, for the gas is nearly odorless. On regaining consciousness the patient has only one-third the nausea associated with ether, though occasionally there may be morphin nausea.

If we profit by Crile's suggestion in anesthetizing children, we are able to spare them a terrifying ordeal. The principle depends on a primitive instinct which prompts one to combat any condition which tends to curtail free respiratory exchange—in other words, to fight against asphyxia; so that if instead of placing a mask over a child's face one gives him the free end of the gas-tube to play with while the nitrous oxid is flowing, directing it in the meantime toward his nose, he will shortly become sleepy and doze off, when the mask may be applied without any protest.

There is less shock under nitrous oxid than under any other anesthetic. Shock cannot develop unless the nerve-cells have an ample supply of usable oxygen. In the production of shock, the latent energy of the central nervous system is changed to kinetic energy; that is, oxidation of the chromatin in the nerve cells is produced as a reaction to the incoming traumatic stimuli, and

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manifests itself in nerve impulses. Provided the stimuli from the periphery are sufficiently severe and long-continued, the central nervous system exhausts itself. Now the underlying principle of nitrous-oxid anesthesia is that it curtails the intracellular ability to use oxygen so that *a priori* one expects that shock would be much less marked under it than under any other which does not depend on this principle for its action. Crile and Prendergast have most ably demonstrated this fact in the laboratory and have shown that in animals traumatism under ether will produce twice as much shock as will traumatism under nitrous oxid. The same fact is seen clinically in our grave traumatic cases. In such, having in view the amelioration of the shock already present, nitrous oxid is the anesthetic of choice. Shock arising from our own operative procedure we never see, on account of the strict avoidance of the factors which are causative in its production.

The object of a surgical operation is not only to cure the disease but also to return the patient in the best physical condition and in the least time to his position in society, subjecting him in the meantime to the least possible danger. I think that nitrous-oxid anesthesia when used in connection with local blocking of the operative field, best furthers these aims. Technically this form of anesthesia is more difficult and exacting for the surgeon, yet I feel that we are amply repaid in sacrificing our convenience for the best interests of the patient because, first, our patients have returned to their work in progressively better condition; secondly, our mortality has progressively decreased so that in the last thousand cases in the surgical service at Lakeside Hospital in which anesthesia was given by the anoci method, there was a total mortality of only 0.8 per cent. In fact, the comfort of the patient at large has become such a marked feature of this method that the public with us is coming to demand this dual form of anesthetic.

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INTRATRACHEAL INSUFFLATION ANESTHESIA (MELTZER-AUER)

REPORT OF A SERIES OF FOUR HUNDRED AND TWELVE CASES

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Meltzer and Auer have shown that continuous insufflation or air into the trachea under moderate pressure is capable of ventilating the pulmonary alveoli, of effecting the necessary exchange of oxygen and carbon dioxid and sustaining life for many hours when all respiratory movements have been abolished by curare.

They have shown that it is the most effective and ideal method of artificial respiration known. It then occurred to them that it might be a means of introducing ether vapor into the respiratory tract, and the extensive and careful series of experiments by which they developed the method of intratracheal insufflation anesthesia are too recent and well known to require review in detail.

This paper will deal simply with personal experience with the method on my service at the Roosevelt Hospital during the past two years in a series of 412 cases, including a great variety of conditions, in many of which we believe it to possess special advantages.

The cases of the series were distributed as follows:

Locations of Operations	No.
Head and neck exclusion of goiter	77
Goiter and exophthalmic goiter	21
Thorax	17
Breast	25
Abdomen	137
Kidney and ureter	25
Miscellaneous	110
Total	412

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There have been no deaths or serious accidents in our series. When the tube is once in the trachea one has ready for instant use the most perfect means now known for the artificial respiration; consequently we have used it by preference in our most difficult and critical cases. We do not use the method to the exclusion of other forms of general anesthesia by any means. Gas and ether, gas and oxygen, drop ether, combined local and general anesthesia and pharyngeal insufflation are employed freely, the attempt being made to fit the anesthetic to the patient and not the reverse, but we do find many conditions in which we believe the intratracheal method to have distinct advantages. During the period in question 2,155 operations have been performed on the second surgical division, less than 20 per cent. of the total under intratracheal anesthesia.

Difficulty of intubation is and probably will continue to be the chief obstacle to a more general use of the intratracheal method. The difficulty, however, has been greatly exaggerated; all of our interns acquire the knack very readily and have trouble in only a small percentage of the cases.

In some cases the difficulty is real, for example, in obese patients with short and thick necks, or in those who do not relax readily under the preliminary anesthesia, for good relaxation is essential to easy intubation.

Sometimes the anesthetist will fail after several attempts, the tube entering the esophagus each time, causing irritating delay and prolongation of the preliminary anesthesia. When this occurs after two or three attempts it is our custom to have another man try, and often, although no more skilful, he will succeed at once as the first man, having once lost the way, is apt to repeat his mistake.

We have tried the Boothby-Cotton curved guide and other devices for intubating by the sense of touch, but prefer and use almost exclusively the Jackson direct-vision laryngoscope.

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The anesthesia is essentially light, and in a few alcoholics and robust adults we have had difficulty in securing quiet anesthesia and good relaxation. The use of a preliminary hypodermic of morphin and atropin in such cases generally obviates this trouble, and in no instance during the past year have we had to abandon the method on this account.

SAFETY OF THE METHOD

With a suitable apparatus (many such have been devised, some simple, some very elaborate) we believe that the method is absolutely safe if certain cardinal principles of technic are understood and carefully observed:

1. Intubation should be done by direct vision, or, if by touch, with the utmost care to avoid trauma to the larynx or trachea.

2. The tube must not be too large, its diameter not more than half that of the glottis; 24 F. should be the maximum for the average adult, ranging down to 18 F. or even smaller according to the size of the larynx and of the patient.

3. The tube must not be inserted farther than 26 cm. from the incisor teeth; that is, its tip should be at least from 1 to 2 inches above the bifurcation of the trachea. A tube pushed on down into a bronchus and plugging it might cause serious mischief.

4. Overpressure must be carefully guarded against, best by a suitable safety-valve attached to the apparatus. The average pressure used is from 18 to 25 mm. of mercury; from 35 to 40 mm. is a safe maximum. If from a defect in the apparatus or from any reason the pressure is not known and under absolute control, the insufflation should be discontinued at once.

5. If the tube enters the esophagus by mistake, it should be disconnected and pressure made on the epigastrium to deflate the stomach before it is withdrawn and replaced in the trachea. We have had this happen

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a number of times, but have never seen any untoward results.

6. The ether vapor should be of moderate concentration, and must be absolutely free from droplets or spray of liquid ether. The apparatus devised by Dr. Karl Connell, assistant surgeon to the Roosevelt Hospital, has enabled us to make accurate observations as to the strength of ether required. The maximum strength used for maintaining anesthesia is 21 per cent. by weight, and this is graded down to about 14 per cent. as the operation proceeds. We have had no experience with higher degrees of concentration, but would fear possible pulmonary irritation.

SHOCK

We are convinced that shock is noticeably less with insufflation than with other methods of etherization, and believe that it is largely due to the complete relief of respiratory strain and the abundance of air continually present and rapidly renewed in the pulmonary alveoli. Dr. Meltzer has aptly referred to it as a luxury of respiration. The even delivery of well-diluted ether vapor and the accurate control of its strength is probably also a factor. The coincident relief of strain on the circulation is especially striking in operations for exophthalmic goiter and in severe and prolonged operations of various kinds, especially in anemic or debilitated patients.

Since we have used insufflation anesthesia in our most serious cases, we have rarely needed the intravenous saline infusions which we use during or at the termination of the operation, if the pulse shows signs of weakness or there is a marked fall in blood-pressure. This is not because we have lost faith in the saline, nor yet because the type of cases has changed; but I believe that fewer cases show evidence of shock since insufflation has been used in just the class of cases that formerly called for stimulation.

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The relief of strain on respiration and circulation necessarily means a similar effect on the central nervous system, and this is shown in the absence of postoperative depression and the rapid recovery from the effects of the anesthetic and the operation.

PNEUMONIA

Experimental and clinical evidence has shown conclusively that neither pneumonia nor bronchial irritation is caused by insufflation anesthesia. Our experience coincides with this view, for while there have been in our series six cases of postoperative pulmonary complications, three only could be considered as possible ether pneumonias, and in none of these do we believe that the insufflation was responsible *per se*. It will bear repetition in relation to this point that the cases of this series have included the most difficult and serious of a busy service in the heart of a great city, on which is thrown a large number of desperately ill patients.

As this question is of vital importance in judging the method, brief notes of these cases are given.

We believe that insufflation not only does not cause bronchial irritation or pneumonia, but that it acts as a preventive, first, in bad breathers who are more or less insufficiently oxygenated and under respiratory strain, and who are continually aspirating mucus and saliva, and, secondly, in operations about the mouth and pharynx, by preventing aspiration of blood and detritus. This is of the greatest benefit in excisions of the tongue or jaw and various operations of the mouth, nose and pharynx. Such operations are greatly simplified by the use of the method, and the necessity of ever having to resort to a preliminary tracheotomy is practically eliminated. In this respect pharyngeal insufflation cannot take the place of the intratracheal method.

Of the six cases of pulmonary complications, two have already been reported.[1]

1. Peck, Charles H.: Intratracheal Insufflation Anesthesia, Ann. Surg., July, 1912, p. 193.

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The other four cases are briefly as follows:

CASE 1.—M. G., man aged 45 years, was operated on Oct. 12, 1912, for acute septic cholecystitis with extensive localized peritonitis and perihepatitis. Cholecystostomy was performed with prolonged drainage of gall-bladder and suppuration of wound. The abdominal wound broke open on the twelfth day. Right lower lobe pneumonia developed on the second day, signs persisting about five days. The patient recovered. While the pneumonia was in all probability a complication of the disease and not due to the anesthesia, ether pneumonia cannot be excluded.

CASE 2.—J. A., woman aged 25 years, Syrian, operated on Nov. 15, 1912, for tuberculosis of rib and thoracic wall, was emaciated and showed signs of pulmonary tuberculosis. Right lower lobe pneumonia developed twenty-four hours after operation; later the upper lobe was involved; there were defervescence and recovery after a sharp course of eight days. This was a case in which the administration of ether in any form was an error; the pneumonia was as likely due to the preliminary anesthesia as to the insufflation.

CASE 3.—G. B., man aged 64 years, was operated on Dec. 7, 1912, for extensive indurated mass in pyloric region of stomach, probably carcinomatous and ulcerated. A palliative gastro-enterostomy was done. There were signs of consolidation in the right lower lobe, first detected six days after operation. Death occurred from pulmonary abscess with surrounding zone of consolidation twenty days after operation. This case requires no comment as it was evidently a complication of the disease and not due to the anesthesia.

CASE 4.—P. G., man aged 35 years, was operated on Jan. 16, 1913, for obscure abdominal symptoms. A malformation of liver (diminutive right lobe), great hypertrophy of omentum, and chronic appendicitis were found; there was a good deal of manipulation in the region of the liver during exploration. The preliminary anesthesia in this case was unduly long and deep, lasting thirty minutes. The intubation was accomplished only after repeated trials; the anesthetist was a beginner. Right lower lobe pneumonia developed promptly, subsided after five days and the patient made a good recovery. The preliminary anesthesia in this instance was unquestionably responsible for the pneumonia.

We have had no laryngitis or loss of phonation; when it occurs it is probably due to the use of too large a tube or to trauma in intubating.

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Sore throat with pain on swallowing lasting a few days has occurred in a number of cases, due always to direct trauma to the pharynx in intubating.

Vomiting is less than in ordinary etherization, and seems to depend largely on the length and degree of preliminary anesthesia required to produce sufficient relaxation for intubation, or on the nature of the illness itself.

In 141 insufflations observed since January 1 by our present intern anesthetist, Dr. White, thirty-two patients vomited once (22.7 per cent.), twenty-four vomited twice (17 per cent.), and six vomited several times (4.2 per cent.), a total of sixty-two (43.9 per cent.).

For positive pressure in thoracic operations it is fast supplanting other more cumbersome methods, as, in addition to the facility with which the degree of pressure can be controlled, the automatic ventilation of the lungs is of the greatest advantage. The far-reaching influence which intratracheal insufflation will have on the development of thoracic surgery in the near future is scarcely appreciated as yet. Heart and great vessels, lungs, bronchi and intrathoracic esophagus, are accessible and approached with increasing safety.

CONCLUSIONS

1. Intratracheal insufflation, administered with accurate control of the strength and amount of ether vapor, is a new principle in anesthesia which in certain classes of cases has many advantages over other methods.

2. The difficulty of intubating and the necessity of inducing full surgical anesthesia before this can be accomplished makes this a method unsuitable for many short, simple operations. Its use should be restricted to the cases in which it has special advantages.

3. It is absolutely safe both as to administration and freedom from deleterious after-effects if a proper apparatus is used and the simple precautions mentioned in detail are observed.

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4. It is an ideal method of differential pressure for operations involving the opening of one or both pleural cavities, greatly reducing the danger of intrathoracic operations.

5. It greatly lessens operative shock: (*a*) through the absolute relief of strain on the respiratory apparatus and coincident freedom from strain on the circulatory apparatus and the central nervous system, and (*b*) from the even, advantageous degree of anesthesia maintained. This is especially evident in aged patients, in those cachectic from malignant disease or anemia and debilitated from other causes. The disparagement of ether as an anesthetic as compared to nitrous oxid, so popular of late among the advocates of the latter, is based on observations of faulty methods of ether administration rather than the inherent toxic effect of the drug itself. The wide margin of safety with ether has so long permitted abuse with this drug that faulty technic has been assumed by its opponents as customary in its administration.

6. It prevents aspiration of mucus or saliva, vomitus, blood or other foreign matter into the trachea, simplifying and decreasing the danger of operations on the tongue, jaws, mouth, nose or pharynx, preventing aspiration pneumonia, and practically eliminating the necessity of preliminary tracheotomy in such cases.

7. It is especially useful in operations about the head and neck. The anesthetist is out of the way; the operative field is easily kept sterile and obstruction of the upper air-passages is absolutely prevented. The same may be said of operations on the kidney, the spine and in awkward positions in general.

8. The degree of anesthesia is under perfect control. Overetherization is impossible at or below 21 per cent. by weight of ether vapor. Insufflation of pure air for the last few moments of the operation hastens the recovery of consciousness and minimizes the after-effects.

30 West Fiftieth Street.

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LOCAL ANESTHESIA

JAMES F. MITCHELL, M.D.
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In 1907 at the meeting of the American Medical Association at Atlantic City, I presented a paper on local anesthesia and in the following year a report through the anesthesia commission on the extent to which it was used in this country. Since that time there have been important developments; the field has been broadened and the popularity of the method has increased both at home and abroad. It has seemed that a general review of this development might be of interest.

Probably the one greatest factor has been the introduction of novocain as a substitute for cocain. First clinically tested by Heinrich Braun in 1905 and extolled by him in several papers,[1] it has been generally adopted and is now recognized as the best and safest substance for the production of local anesthesia. It has the great advantage of being about seven times less toxic than cocain, and its solutions stand boiling. It is conveniently supplied in tablet form in combination with synthetic suprarenin. In preparing solutions these tablets are dissolved in 0.6 per cent. salt solution to which is added a little hydrochloric acid. For infiltration purposes 0.25 to 0.5 per cent. solutions are used and as much as 125 c.c. of the latter strength may be injected with perfect safety. Braun states that he has repeatedly used as much as 250 c.c. (1.25 gms.) of this strength and has never seen trouble therefrom, but cau-

1. Braun: Deutsch. med. Wchnschr., 1905, xxxi, 1667; Deutsch. Ztschr. f. Chir., 1911, iii, 321; Lokalanesthesie, Edition 3, 1913.

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tions that we should in spite of this ever bear in mind that novocain is a poison. We can therefore infiltrate very extensively with no fear of toxic effect, a fact which accounts in large part for the extension of local methods into new fields.

Anesthesia is probably obtained somewhat more quickly with cocain and where small amounts only are necessary I still use it; but, for all larger infiltrations, novocain is the choice.

Urea and quinin hydrochlorid, suggested by Thibault and popularized by Hertzler[2] and others, is another anesthetizing agent which has proved of value. It has in its favor practically negative toxicity, its control of postoperative bleeding and the fact that anesthesia obtained by it may last for several hours or days, thus eliminating postoperative pain. It is thus well fitted for rectal work and is said to be especially useful in the removal of tonsils. The ordinary strength of the infiltration solution is from 0.5 to 1 per cent. Anesthesia is obtained slowly and one should wait at least fifteen or twenty minutes after the injection before beginning an operation.

In 1908 Bier[3] presented an entirely new method of obtaining anesthesia of the limbs through the medium of intravenous injection of novocain. The limb is rendered perfectly ischemic by the application of a rubber bandage from the periphery to a little above the point at which a vein is to be exposed. At the central edge of this expulsion bandage an Esmarch tourniquet is tightly placed over a broad surface. The expulsion bandage is removed and a handbreadth or so below the first tourniquet a second is applied. Between these two a vein is exposed, usually the internal saphenous in the leg and the cephalic, median or basilic in the arm. The vein is ligated centrally and a cannula introduced distally and tied in place. Novocain (0.5 per cent.) is then forced

2. Hertzler, A. E., Brewster, Roger B., and Rogers, Ford B.: Quinin and Urea Hydrochlorid as a Local Anesthetic, THE JOURNAL A. M. A., Oct. 23, 1909, p. 1393.
3. Bier: Arch. f. klin. Chir., 1908, lxxxvi, 1007.

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into the vein under considerable pressure—from 60 to 100 c.c. in the leg, 40 to 70 c.c. in the arm—the cannula is removed and the vein tied. In one or two minutes there is complete anesthesia in the area between the tourniquets—direct anesthesia—and in ten or fifteen minutes in the parts distal to the second tourniquet—indirect anesthesia. There is also complete motor paralysis; so that there is obtained as thorough relaxation as under general narcosis, rendering this method applicable for any operative procedure. The anesthesia persists as long as the central tourniquet is left in place and disappears quickly after its removal. Bier's longest operation lasted one and three-quarter hours. Hayward[4] in November, 1912, reports from Bier's clinic 375 operations under vein anesthesia; including amputations, joint resections, fixation of fractures, tendon transplantations, removal of varicose veins, etc. There was complete anesthesia in 93 per cent. and in only 3 per cent. was narcosis necessary. There were no accidents or bad results. Kaerger[5] from the same clinic reports 150 further cases and gives the details of the method as applied to minor operations on the hand and foot, a most useful procedure in office or dispensary work.

Undoubtedly venous anesthesia furnishes us a useful addition to our means of carrying out operations in non-septic conditions of the extremities, but the discomfort of the tourniquet is often a factor which must be considered.

Goyanes[6] in 1909 suggested a similar procedure except that he injected the anesthetic by means of a fine needle directly into an exposed artery. Ransohoff[7] in 1909-10 used a similar method, but did not exsanguinate before injecting. The intra-arterial method seems to show no

4. Hayward: Arch. f. klin. Chir., 1912, xcix, 993.
5. Kaerger: Arch. f. klin. Chir., 1912, xcix, 983.
6. Goyanes: Rev. clin. de Madrid, 1909, i, 12; Zentralbl. f. Chir., 1909, xxxvi, 791; Zentralbl. f. Chir., 1911, xxxviii, 1600.
7. Ransohoff, J. L.: New Method for Inducing Local Anesthesia, Lancet-Clinic, Aug. 7, 1909; abstr., THE JOURNAL A. M. A., 1909, p. 741; Ann. Surg., 1910, li, 453.

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advantages over the venous and has the disadvantage that arteries are more difficult of access than superficial veins.

A knowledge of sensory nerve-distribution renders easy the anesthetization of distal portions of an arm or leg by perineural or endoneural injection. Crile[8] in 1902 injected the several cords of the brachial plexus after exposing them. Hirschel[9] first obtained anesthesia of the whole arm by injecting the plexus in the axilla without incising the skin and Kulenkampff,[10] stimulated by his paper, has worked out a method by which he reaches the plexus above the clavicle. He gives anatomic details and reports twenty-five cases, in fifteen of which total anesthesia was obtained and in only three of which a little ether was needed.

For the leg Läwen[11] in 1911 presented the technic of reaching through skin punctures the various nerves so as to anesthetize the whole limb and in 1912 Keppler[12] published an extensive article with further details and reports of cases. Babitzki[13] quite recently described a method whereby the sciatic nerve can be reached at the foramen for direct endoneural injection, the needle being introduced through the gluteal muscles and controlled by a finger in the rectum.

Franke and Posner[14] contribute from the Heidelberg clinic in 1912 a study of the sensory nerves of the pelvis and perineum with the technic of reaching them by puncture. They report several perineal prostatectomies and in a footnote ten additional ones, all completed under absolute anesthesia.

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8. Crile, G. W.: An Experimental and Clinical Research into Cocain and Eucain, THE JOURNAL A. M. A., Feb. 22, 1902, p. 491; The Results of Operations, Especially Abdominal, Performed on the Principle of Anoci-Association, ibid., July 13, 1912, p. 114.
9. Hirschel: München. med. Wchnschr., 1912, lix, 1218.
10. Kulenkampff: Zentralbl. f. Chir., 1911, xxxviii, 1337.
11. Läwen: Deutsch. Ztschr. f. Chir., 1911, iii, 252; München. med. Wchnschr., 1911, lviii, 1390.
12. Keppler: Arch. f. Chir., 1912, c, 501.
13. Babitzki: Zentralbl. f. Chir., 1913, xl, 227.
14. Franke and Posner: Arch. f. klin. Chir., 1912, xlix, 139.

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Ruge[15] cites numerous vaginal operations and two complete vaginal hysterectomies accomplished painlessly under simple infiltration with novocain, and from Knight Smith[16] comes a report of two successful and painless cesarean sections by the same method. Läwen's method of paravertebral nerve-blocking, reaching the nerves at the spinous processes of the vertebrae, was applied by Finsterer[17] to abdominal work. He obtained perfect anesthesia in four out of six cases and recommends this procedure especially for removal of the appendix. Kappis,[18] applying the same method, has removed the kidney in three cases; Schumacher[19] recites thirty-five thoracoplasties and Heidenhain[20] four laminectomies. Kappis found that absolute anesthesia could thus be obtained for operations on the gall-bladder and stomach. This is of particular interest in showing that the vagus is not concerned with the sensory innervation of this region.

The head has been a special field of investigation. In the papers of Braun, Offerhaus[21] and Härtel,[22] not only are the methods of reaching the individual branches of the fifth nerve accurately mapped out; but even the injection of the gasserian ganglion itself is detailed with mathematical accuracy. All operations in the field of supply of the fifth nerve are done by preference under local anesthesia by these surgeons. Braun states that local anesthesia has made of resection of the upper jaw quite another operation, which may still have its horrors and its difficulties but has quite lost its danger; that patients come through it with absolutely no collapse and quite as fresh as before it began and scarcely need to go to bed. Of ten patients he has lost none and had no pulmonary complications. Härtel reports nine cases in equally glowing terms.

15. Ruge: Zentralbl. f. Gynäk., 1912, xxxvi, 561.
16. Smith: Surg., Gynec. and Obst., 1910, xi, 423.
17. Finsterer: Zentralbl. f. Chir., 1912, xxxix, 601.
18. Kappis: Zentralbl. f. Chir., 1912, xxxix, 249.
19. Schumacher: Zentralbl. f. Chir., 1912, xxxix, 252.
20. Heidenhain: Zentralbl. f. Chir., 1912, xxxix, 281.
21. Offerhaus: Arch. f. klin. Chir., 1910, xcii, 1.
22. Härtel: Verhandl. d. deutsch. Gesellsch. f. Chir., 1911. I, 243.

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Excision of the tongue or lower jaw comes under the same category. Härtel's brilliant article,[23] published in December, 1912, details the anatomic approach to the gasserian ganglion by needle puncture and its reading would well repay any one interested either in the subject under discussion or the injection treatment of tic douloureux. The ganglion is reached through the foramen ovale and injected with 1 c.c. of 2 per cent. novocain-suprarenin solution. Anesthesia is obtained almost immediately and lasts about an hour and a half. Härtel reports sixteen operations in which he has used this method, in nine of which the ganglion was injected on both sides. The operations included six resections of the upper jaw, three of the lower jaw and two of the tongue. Besides these there were fourteen patients in whom the ganglion was injected with alcohol. In all there were thirty-nine attempts at puncture of the ganglion, of which he reports twenty-eight as easy, seven difficult and four with no anesthesia obtained, so that the ganglion was probably not reached.

The neck had long been a favorite situation for work under local anesthesia and the accomplishments of Bier, Kocher and others are well known. The progress in this field in the last few years is along old lines, but the possibilities have been greatly increased by the introduction of novocain because of the enormous amount of the solution which can be used. Braun reports, that from 1908 to 1911, his 150 thyroidectomies have without exception been done under local anesthesia.

To one accustomed to the use of cocain administered as sparingly as possible, it is surprising how simple and painless these operations become with the generous novocain infiltration as recommended by Braun. The third edition of his book on local anesthesia, just published in the last few weeks, is a storehouse of interesting and wonderful descriptions of the conquest of sensation in all parts of the body. The technic of the injections for

23. Härtel: Arch. f. klin. Chir., 1912, c, 193.

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various operative procedures is given in detail, illustrated by charts and photographs in such a way as to make a practical working guide.

The work of Crile on shock and anesthesia has been of great value. Showing that shock has as its basis a definite injury to nerve cells, he has sought to lessen this by interrupting the conduction paths between the brain and the field of operation, a principle which he has designated "anoci-association." The three factors concerned are hemorrhage, anesthesia and trauma, of which the latter two are the most difficult to control. The influence of trauma, he finds, can be obliterated by blocking the conduction paths by means of a liberal infiltration with 0.25 per cent. novocain. Bloodgood[24] indorses and confirms Crile's work and urges surgeons to familiarize themselves with the technic by applying it not only to the handicapped patient, to whom it may be the deciding factor of safety, but in daily routine work. He believes this will also add to the comfort of the ordinary individual who can stand considerable operative trauma and bad anesthesia. Bloodgood states that only by the aid of the sphygmomanometer can the surgeon estimate the real significance of the traumatic factor. He finds that there is no change in blood-pressure in operations under local anesthesia so long as no pain is inflicted; and familiarity with recent methods should enable one to obtain a painless operative field in the vast majority of cases. Braun's description of excision of the upper jaw or tongue is a striking example of the protection against shock which local methods afford. As he says, the patients scarcely need to go to bed.

Nowhere is this better exemplified than in surgery of the aged. How many individuals cannot any one of us recall who have been refused the possible benefits of surgery because of age? We can all remember epitheliomas of the lip, in which the lymph nodes have not been removed, because it was not thought wise to pro-

24. Bloodgood: Progr. Med., 1912, iv, No. 4, p. 207.

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long anesthesia; fractures which have been left to vicious or no union; or hernias doomed to the uncertain protection of a truss and the dangers of strangulation. In these cases a mastery of local methods means safety, and by a judicious combination of local anesthesia with a little nitrous oxid at crucial moments the possibilities are without limit.

The removal of cervical lymph-nodes in epithelioma of the lip is so painless as to cause no disturbance whatever. My routine is to infiltrate the neck thoroughly with 0.5 per cent. novocain and then proceed with the excision of the growth on the lip. By the time this is finished and the gloves changed, anesthesia in the neck is so well established that the dissection can be carried out at will. I have done this on a man well along in the eighties and had him walking about next day. In a man of 97 I removed a large epithelioma of the cheek involving the zygoma. This was especially interesting in that a section of Steno's duct was removed and an end-to-end suture made with resulting patency of the duct. The operation lasted nearly two hours and was followed by no shock or depression.

In the treatment of fractures the combined method has been found most useful. Thus in a feeble old lady of 85 with a long, oblique fracture of the shaft of the left femur with great displacement, I was able to expose the bone under infiltration anesthesia. She was then given a few whiffs of nitrous oxid and the fragments brought into line. During the drilling of the bone and the application of the plate, she was conscious and talking, but felt no pain. She was gotten up in a chair the next day and left the hospital in six weeks walking and without crutches or cane.

In hernia operations, I do not consider old age a contra-indication. Hernias of all varieties, I believe, are best done under local anesthesia; and, except in very young children, I recall no case in which it has been necessary to resort to narcosis in the last few years. My

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oldest patient, a man of 98 with a strangulated inguinal hernia, was operated on over a year ago, the bowel in good condition. He made a good recovery and is now pursuing his work as an artist. In a woman of 84 with an eight-day strangulated hernia with gangrenous small intestine, a two-stage operation was done. The bowel was first brought out and opened, and on the following day her condition was so good that a resection and Murphy button anastomosis was made. Her recovery was uneventful.

In presenting this review of the literature of the last few years, I have by no means exhausted or done justice to the material, but have tried to give some idea of the general progress. I have endeavored to point out some of the possibilities and to show the degree of perfection which can be obtained by such skilled masters as Braun, Bier, Härtel and others.

In this busy American life of ours, I cannot believe that many of us will ever take the time or have the patience to attain that degree of skill. I hope, however, that some of us may persevere and be rewarded by finding how much ease comes with experience. As Blood-good states, in speaking of Crile's work, the technic cannot be mastered by restricting its employment to handicapped patients, who are too few to give sufficient experience. The details should be learned by daily experience where absolute success is not so imperative. Above all, I trust the method will not in the future be condemned, as it has been in the past, because of ignorance of its possibilities and inexperience in its application.

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ETHER PERCENTAGES *

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Surgical anesthesia depends on the establishment in the blood and tissues of a definite ether tension, corresponding to about 15 per cent. of ether vapor in the alveolar air. My experience with the Connell anesthetometer, as well as the physiologic observations of Waller of London University, has demonstrated the fact that the "anesthetic tension" varies very little in different patients—the strong, robust alcoholic requires little, if any, greater ether tension than does a child for the same degree of anesthesia.

In order to induce anesthesia quickly, air containing approximately 30 per cent. of ether vapor should be administered for a period of from two to twelve minutes, depending on the size of the subject in relation to the rapidity of his circulation and respiration. By the early administration of strong ether vapor, diffusion occurs more rapidly from the inspired air, through the walls of the alveoli into the blood, allowing the latter in its turn to more quickly bring about in the tissues the tension of ether vapor requisite for surgical anesthesia. As the required tension is approached, the ether vapor in the inspired air is gradually reduced to 15 per cent. If less than 15 per cent. ether vapor is administered, outward diffusion occurs from the tissues and blood to the air and the anesthesia becomes lighter. On the contrary, the continuous administration of 15 per cent. ether vapor after the "anesthetic

* From the Surgical Service and Respiration Laboratory of the Peter Bent Brigham Hospital.

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tension" is once established does not mean that the patient is receiving more ether, but merely that diffusion both in and out is prevented; in brief, a state of equilibrium is established, and so long as it is maintained a condition of safe ideal surgical anesthesia will exist.

Without question the anesthetomoter devised by Dr. Karl Connell of Roosevelt Hospital, New York, is the ideal apparatus to use. By it the "anesthetic tension" can be rapidly obtained and indefinitely maintained. Unfortunately this apparatus is not available to every one, and it seemed to me desirable that the ether percentages as obtained by the use of our more common forms of apparatus should be determined experimentally. This I have done, as well as to correct—in the light of our new knowledge—some of the erroneous beliefs which are so generally accepted in regard to ether anesthesia.

DESCRIPTION OF APPARATUS

Figure 1 represents the apparatus as set up for determining the percentage of ether vapor obtained by passing air over liquid ether contained in a Woulfe bottle and other "vapor" apparatus. On the left is the Waller gas balance calibrated to read off ether percentages from 1 to 50 direct. The principle is as follows: The small brass counterweight on the left just balances the large glass bulb on the right in air; if now a gas of higher specific gravity is passed into the air-tight balance case, it will exert a greater lifting effect on the larger bulb than on the smaller. The balance beam is divided into equal divisions and marked from the center out on each side from 1 to 50. The weight of the rider is calculated from the difference in volume of the glass bulb and brass weight, so that it will just counterpoise the buoyancy of any percentage of ether by placing it at the corresponding position on the balance beam. Conversely, reading the position of the rider when the balance is in equilibrium will give the percentage of ether

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in the mixture under examination. The apparatus used, with the observations taken during a constant flow of air containing ether vapor, gives percentages accurate to within an error of 1 per cent. Greater accuracy could be obtained by stopping the air-current during an observation and calculating the exact counterpoise weight by the mean swing of the pointer. Accuracy greater than 1 per cent. not being needed for the following experiments, the readings as a rule have been taken without interrupting the current. A thermometer was always placed in the balance, but no change in temperature was produced (less than half a degree) that necessitated a recalculation of the percentages obtained by direct observation. Before beginning a set of experiments the equilibrium of the balance was adjusted for the existing barometer and temperature.

In the center is represented the Richardson ether vapor apparatus; in the experiments, however, I used a 1-liter (1-quart) Woulfe bottle because the thermometer could be introduced into the liquid ether more conveniently by means of the middle opening; the bulb of the thermometer was always submerged. The experiments were started with the bottle two-thirds filled with ether and continued until the surface of the ether fell to the top of the thermometer bulb. In the experiments cited the entire air-current used in each experiment passed over the surface of the ether.

On the right is shown a Bohr 10-liter gas-meter by which the volume of air per minute used during the experiment was obtained. The total volume as inspired by the patient would be the amount given by the meter plus the percentage of ether vapor taken up by the air, corrected to the existing barometric pressure at 37 degrees moist.

EXPERIMENTS AND EXPLANATION OF CHARTS

The air was passed through the meter, from the air-main in the laboratory, at a constant rate; taken over the surface of the ether and from there to the gas-

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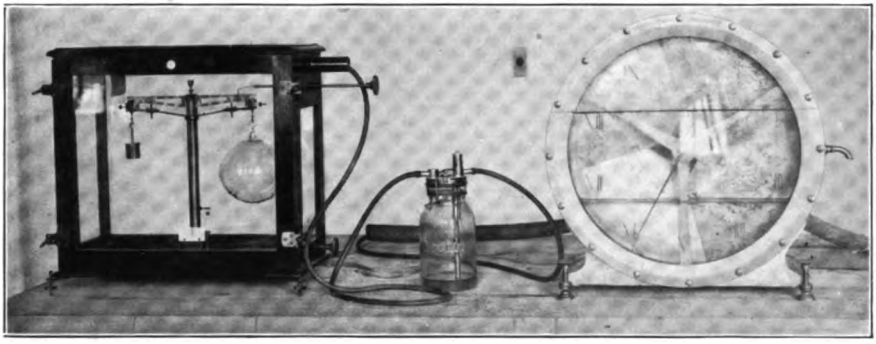

Fig. 1.—Apparatus for determining percentage of ether vapor obtained by passing air over liquid ether.

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balance. The temperature of the liquid ether and percentage of ether vapor were taken simultaneously. In this method there is of necessity a "lag" between the temperature reading and percentage reading, due to

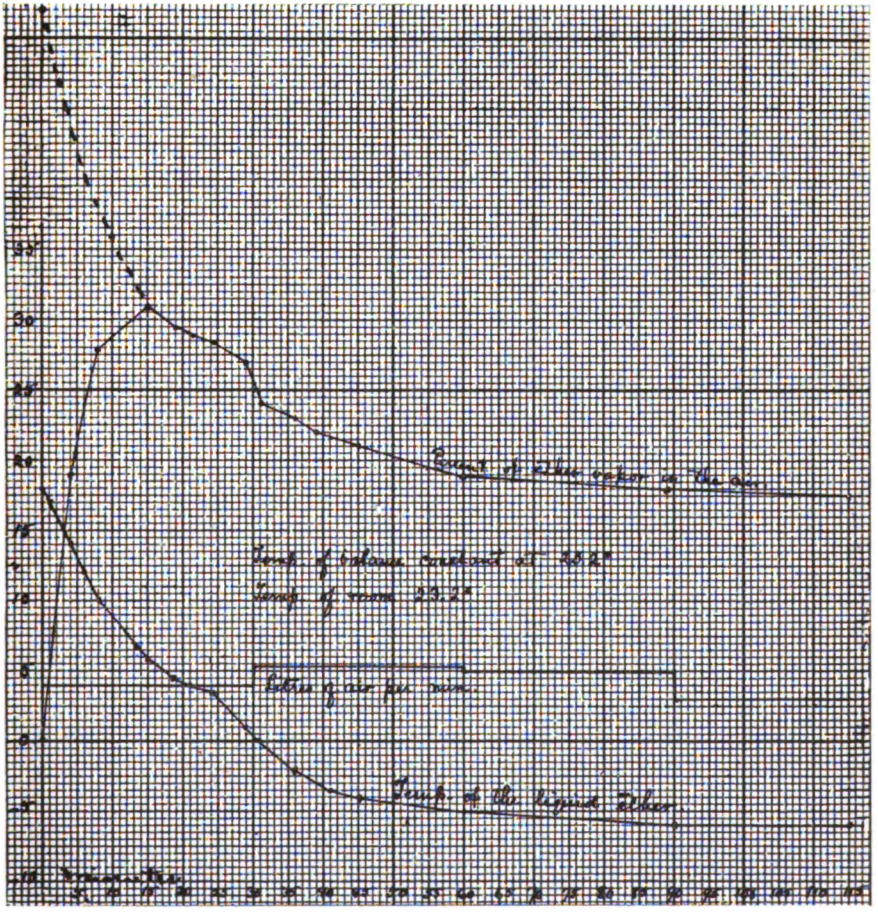

Fig. 2.—Chart of percentages and temperatures. Feb. 17, 1913. Small Woulfe bottle with surface area of ether equaling 50.26 sq. cm. No visible disturbance of surface of ether by current of air.

the fact that a variable time must elapse before the mixture in the balance represents the percentage as given off by the ether at a given temperature. This lag

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is negligible except when the air-current is above 10 liters per minute; when above 10 liters the fall in temperature is so rapid that the results obtained are not so accurate as when run at a slower rate, as will be seen from the curves obtained from the following experiments.

In the chart (Fig. 2) the upper line represents the percentages, and the lower line the temperatures obtained when the air was run at from 4 to 6 liters per minute. The ordinate represents temperature and percentages; the abscissa time in minutes. While the ether is comparatively warm the percentage as recorded by the balance rapidly rises from 0 to 31 and then begins to fall slowly and parallel to the fall in temperature. If the percentage curve is extended backward as represented by the dotted line, it will be seen that at first the ether vapor was very strong—about 52 per cent.—corresponding to a temperature of the liquid ether of about 18 C. (64.4 F.).

Figure 3 is similar to Figure 2 in every respect, the more rapid rise and fall being due to the fact that the rate of flow of the air is twice as fast (10 liters per minute). The percentage curve extended backward by the dotted line gives 56 per cent. for a temperature in the liquid ether of 20 C. (68 F.).

Figure 4 represents an experiment in which the rate of air-flow was increased to 18 liters per minute. This rate corresponds pretty closely to that which an anesthetist would produce by his use of a foot-pump in a case in which the patient is difficult to etherize, for under such circumstances his tendency is to pump faster and faster. It is evident that such rapid pumping (and in deep breathers large volumes are necessary) defeats the very purpose for which it is done, because the large amount of air passing over the ether causes the latter to evaporate very quickly. As a result, the temperature of the liquid ether falls quickly far below 0 C. (32 F.), and therefore the amount of ether vapor in

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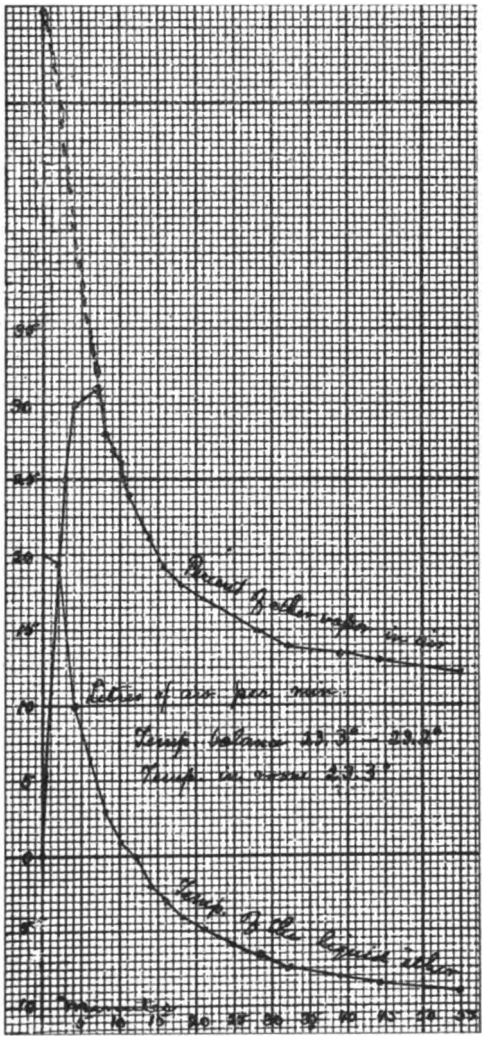

Fig. 3.—Chart of percentages and temperatures. Feb. 18, 1013. Same apparatus.

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the air is less than 15 per cent. Concisely put, the faster the anesthetist pumps the lower will be the ether percentage obtained and the greater the difficulty, if not impossibility, of etherizing the patient. After the experiment had been continued for thirty-seven minutes the Woulfe bottle was placed in a water-bath at a temperature of from 35 to 37 C. (95 to 98.6 F.), with

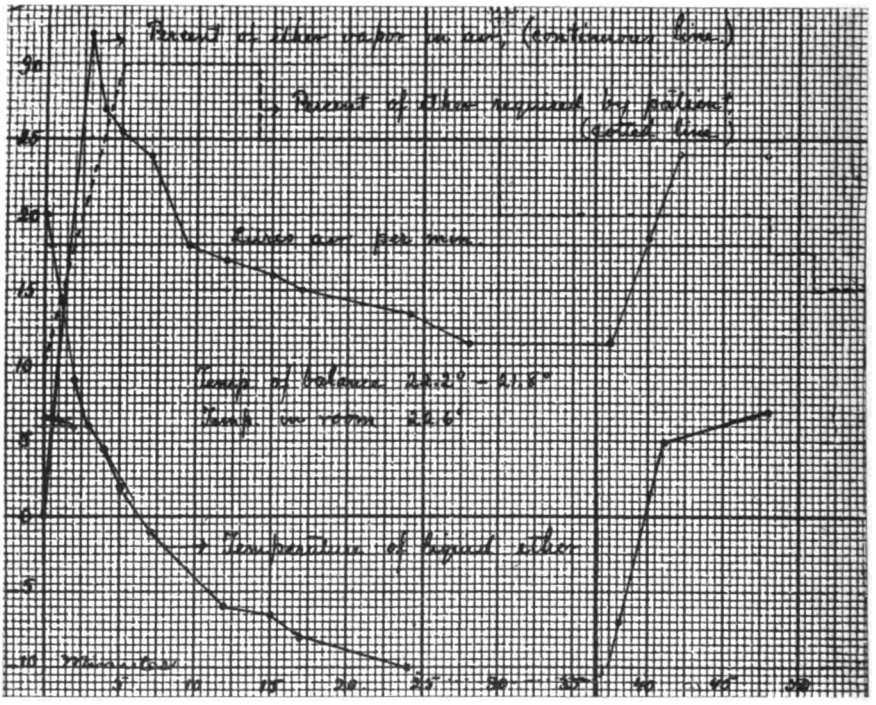

Fig. 4.—Chart of percentages and temperatures. Feb. 18, 1913. Same apparatus. At 37½ minutes the bottle of ether was immersed in water at 35 C. (95 F.).

the result that the temperature of the liquid ether immediately rose and the percentage of ether vapor increased correspondingly. In the chart I have indicated by the heavy dotted line the percentage of ether necessary to induce and maintain anesthesia for the first hour in an operation for cerebellar tumor. I have purposely

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chosen this case as an illustration because the prone position of the patient precluded the possibility of using an absolutely air-tight face-piece; therefore the percentages indicated by the Connell anesthetometer are slightly higher than that actually inhaled by the patient. Except when special precautions are taken, a slight leak is common in clinical work; therefore, the illustration is a true indication of the demands to be made on

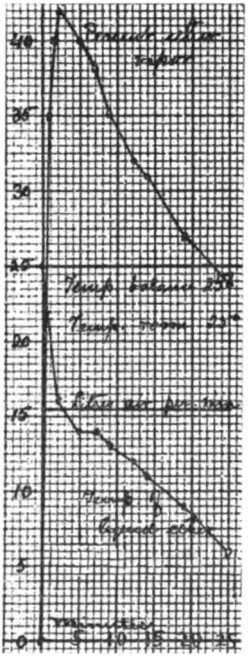

Fig. 5.—Chart of percentages and temperatures. Feb. 21, 1913. Same apparatus. Ether bottle in water-bath at a temperature of from 35 to 37 C. (95 to 98.6 F.).

the vapor apparatus. The distance between the two curves, the upper representing the percentage needed and the lower the actual percentage obtained from passing air over liquid ether, illustrates forcibly the reason that an ordinary apparatus will often not anesthetize a patient. The advantage that can be obtained by immersing the ether bottle in warm water is as strikingly shown by the rise in the ether percentage.

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Furthermore, the fact that throughout the entire experiment the temperature in the balance varied less than 1 degree proves conclusively that any change produced by the warming device cannot be attributed in any way to a change in temperature of the inspired mixture of air and ether. This experiment confirms the earlier work of Cotton and Boothby[1] on the fallacy of warming the inspired air so far as affecting the patient by the temperature is concerned; the present work goes farther, however, and gives the true explanation of the practical value of immersing the bottle containing the ether in a bath of warm water.

Figure 5 illustrates the effect of immersing the ether bottle from the start in a water bath at from 35 to 37 C. (95 to 98.6 F.), with the air flowing at 15 liters per minute. By this means we obtain much higher percentages, so high, in fact, that from the practical point of view, when a water-bath is used, care must be taken to dilute the mixture in some way before it is inspired by the patient. The most common method is to have a short-circuit arrangement which allows part of the air-current to go direct to the patient without passing through the ether bottle. In many cases, however, the strong vapor is used in small amounts and delivered close to the patient's mouth, where it is diluted with the bulk of inspired air.

Figure 6 shows the percentage that would be obtained at a slower rate of air-flow. If a still slower rate was used a still higher percentage would be obtained for a longer time, because the liquid ether would not become so rapidly cooled by its quick evaporation. It must be remembered, however, that the patient may get two or three inspirations consisting of 50 per cent. ether unless care is taken to prevent this. Although no such great danger is present from the inhalation of strong ether vapor as there is of chloroform, yet it should be avoided. For this reason one must never use chloroform in this

1. Cotton and Boothby: The Uselessness of Warming Anesthetic Vapors, Surg., Gynec. and Obst., 1912, xv, 724.

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manner for the well-known reason that one single inspiration of concentrated chloroform may instantly and permanently stop the heart. I have frequently seen a chloroform bottle and ether bottle immersed in a water-bath in the same air-circuit, so that by the simple turn-

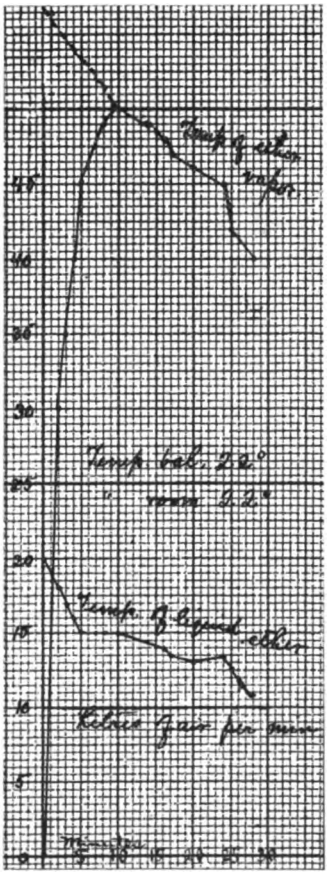

Fig. 6.—Chart of percentages and temperatures. Feb. 25, 1913. Same apparatus. Ether bottle in water at from 35 to 37 C.

ing of a valve the air is made to pass over the chloroform instead of the ether; the purpose of this combination is to control patients difficult to anesthetize with ether. No such difficulty should exist if an ether bottle of suf-

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ficient size (1-quart jar about half full) is used and immersed in water at 35 C. (95 F.). As the boiling-point of ether is 35 C. the water should never exceed this temperature. The water cools rapidly and must be kept up to 35 C. by constant addition of warm water

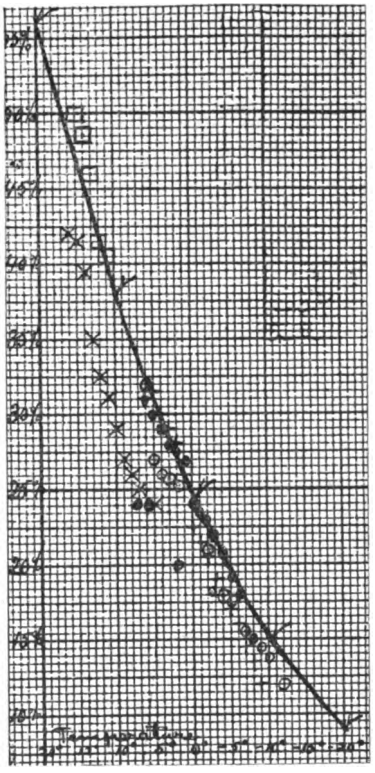

Fig. 7.—Chart of the vapor tension of ether at different temperatures. The points determined in the author's experiments are indicated as follows: Solid dots, points taken from the curve in Figure 2; +, points taken from Figure 3; hollow dots, points taken from Figure 4; hollow dot with diagonal, points taken from Figure 4 after the ether container was placed in water at 35 C.; ×, points taken from Figure 5; hollow squares, points taken from Figure 6. The check marks indicate the points determined by Regnault for the vapor tension of ether at given temperatures; these points are connected by the curve.

by an attendant or by a small electric heater. Water at 35 C. will keep the liquid ether at a temperature of about 15 C. (60 F.) for the average rate of flow of air;

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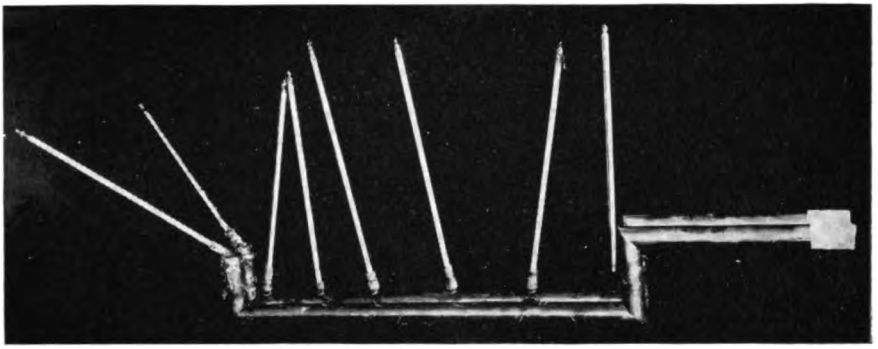

Fig. 8.—Apparatus for determining ether percentages from a mask; tubes for inspiration and expiration, the former having eight thermometers at 2-inch intervals.

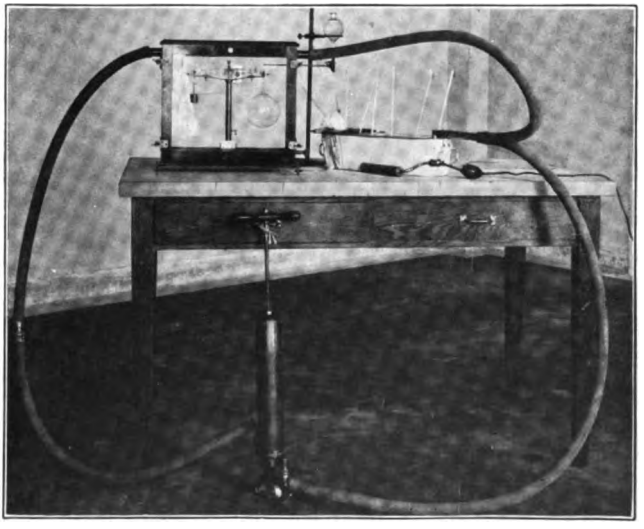

Fig. 9.—Apparatus for determining ether percentages from a mask, complete.

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at this temperature 45 per cent. ether vapor if undiluted with air can be obtained, a percentage far stronger than that which ever should be used without dilution.

In Figure 7 I have plotted the curve of the vapor tension of ether at different temperatures as determined by Regnault.[2] For comparison I have put in the points as determined by me in the preceding experiments. Many of my points fall directly on the true curve and most of the rest very close to it. The points taken from my curve in Figure 5 are the farthest removed from the Regnault curve; the error is due to the "lag" previously mentioned, when the air-current is above 10 liters per minute. The general close agreement between my experimental results and the true curve of the vapor tension of ether substantiates in a very satisfactory manner the fundamental correctness of my observations and deductions therefrom.

This curve can be made of practical use by placing a centigrade thermometer in the liquid ether of the vapor apparatus. At any given temperature of the ether one may be sure that one is obtaining the corresponding ether percentage; then if one has a valve which will accurately shunt the air-current so that one-fifth, one-fourth, one-third, etc., can be passed over the ether and the rest around the ether, a close approximation of the ether percentage which the patient is getting can be readily estimated.

NEW METHOD OF DETERMINING ETHER PERCENTAGES OBTAINED FROM A MASK

I shall now give a brief consideration to the ether percentages obtained from a mask; here, however, not such accurate results are obtainable on account of the difficulty of applying the ether evenly and constantly over the mask and the great variation in percentage produced by the leaking in of air under the mask and through a portion of the gauze not saturated with ether. On account of the size of the dead-space of the balance,

2. Regnault: Chem. Kal., 1912, ii, 105, Table 77.

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the readings taken will give only the average of a considerable number of respirations. Therefore the results obtained must only be considered as an average, since individual inspirations may be irregularly higher and lower.

For this problem I have arranged the apparatus shown in Figures 8 and 9. The artificial mouth and trachea of the patient consists of two brass tubes of ¾ inch diameter; one of these is used for "inspiration" and the other for "expiration." The tube for inspiration has a series of eight thermometers spaced at intervals of 2 inches, the first being directly at the mouth. The air is conducted back to the mask by the other brass tube containing water to saturate the air with moisture. This method affects the mask with warmth and moisture in the same manner as expired air, and yet does not influence the thermometers; therefore the temperatures as taken from the intake tubes will give a very fair indication of the temperature of air and ether as inspired by a real patient. The brass tubes or "artificial trachea" are immersed in a water-bath kept at a constant temperature of 37 C. (98.6 F., body temperature) by means of a small electric heater shown lying outside the bath. The mask used is placed on a little shelf that acts as a "face" and the mouth of the trachea opens directly under it. Ether is administered by a small constantly running stream, regulated to the desired amount by a stop-cock from the little glass container shown over the top of the hose; a glass tube, which can be easily moved, takes the ether to the mask and distributes it over the mask. The hand-pump was especially made for me, and by means of a check-nut can be set so that a single stroke will will give any amount desired up to 1,500 c.c.; the number of strokes per minute and therefore the volume per minute are regulated as desired. The pump sucks in the air through the intake tube from the trachea and delivers it through the outlet tube to the balance; from the balance the air passes back through the second trachea to the mask.

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In Table 1 are shown four of the many experiments by this method. The first two were made for the particular purpose of obtaining the temperature of the air and ether vapor as it enters the mouth of the patient. In the first the subject is supposed to be breathing ordinarily as would be expected of a moderately weak patient in whom loss of heat, if of considerable amount, would be an important factor. In this case, during the stage of induction which requires 30 per cent. ether, the temperature of the inspired mixture falls to 12 C. (53.6 F.); as soon as anesthesia is induced, 19 per cent. ether is sufficient, and with this percentage the temperature rises to 23 C. (73.4 F.).* Still later, when only 15 per cent. ether is needed, the temperature would be even higher. This experiment has been used as the basis for caluculating the number of calories of heat lost by a patient due to the warming of the anesthetic vapor; this point will be considered further in a moment. The second experiment shows the temperature change that would occur in a vigorous person breathing moderately deep.

The last two experiments shown in Table 1 illustrate the highest possible percentages that can be obtained from a mask. In the first of these the patient is supposed to be a vigorous alcoholic, breathing deeply at the rate of 24 liters per minute. The well-known increase in depth of respirations in alcoholics appears to be due to the greater excitatory power of ether on the respiratory center in such subjects than exists in the case of non-alcoholics. The more expert the anesthetist the less excitatory effect does the ether have, and the easier it is to induce anesthesia. It is very hard for the beginner to increase the percentage of ether rapidly and yet smoothly without causing "suffocation" and therefore deep breathing on the part of the patient.

The difficulty of obtaining the high percentages requisite for the rapid induction of anesthesia in a deep

* Room temperature equals 24 C.

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TABLE 1.—TEMPERATURE OF AIR AND ETHER VAPOR AS IT ENTERS MOUTH OF PATIENT

EXPERIMENT 1.—Vol. of stroke, 400 c.c. Strokes per min., 20. Vol. per min., 8 L. Ether per min., 5 c.c. Plain gauze without mask. Ether applied in small amounts frequently as in practice.

Time	Ether Per Cent.	Amount of Ether	Temperatures of inspired air								Notes
			I	II	III	IV	V	VI	VII	Bath	
3.50	0	0	..	..	..	..	..	..	..	..	Air.
3.59	0	0	29	31	35	36	37	37	38	40	Air.
4.00	..	Started	..	..	..	..	..	..	..	..	
4.10	30	.....	12	14	27	30	30	33	33	38	
4.17	19	90 c.c.	23	25	31	33	34	35	35	38	

EXPERIMENT 2.—Vol. of stroke, 800 c.c. Strokes per min., 20. Vol. per min., 16 L. Ether per min., 9 c.c. Plain gauze without mask. Ether applied in small amounts frequently as in practice.

Time	Ether Per Cent.	Amount of Ether	Temperatures of inspired air								Notes
			I	II	III	IV	V	VI	VII	Bath	
4.20	..	Started	..	..	..	..	..	..	..	..	
4.35	30	.....	5	7	17	24	24	27	27	37	
4.38	15	160 c.c.	16	18	23	28	28	30	30	36	

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EXPERIMENT 3.—Vol. of stroke, 800 c.c. Strokes per min., 30. Vol. per min., 24 L. Ether per min., 20 c.c. Wire mask covered with sixteen layers of gauze. Ether applied in constant stream in a sufficient quantity to keep the mask saturated as shown by dripping.

Time	Ether Per Cent.	Amount of Ether	Temperatures of inspired air								Notes
			I	II	III	IV	V	VI	VII	Bath	
10.12	..	Started	..	..	..	..	..	..	..	..	As indicated by "on" and "off" the effect of applying hands closely to mask is shown in this experiment.
10.18	31 (off)	140 c.c.	16	18	..	..	..	..	..	..	
10.23	35 (on)	360 c.c.	15	17	..	..	..	..	..	..	
10.33	30 (off)	530 c.c.	..	..	..	..	..	..	..	..	
10.40	32 (on)	680 c.c.	15	17	..	..	..	..	..	..	
10.42	29 (off)	720 c.c.	..	..	..	..	..	..	..	..	
10.54	31 (on)	.....	..	..	..	..	..	..	..	..	
10.59	29 (off)	900 c.c.	..	..	..	..	..	..	..	..	

EXPERIMENT 4.—Vol. of stroke, 400 c.c. Strokes per min., 30. Vol. per min., 12 L. Ether per min., ? Wire mask covered with sixteen layers of gauze. Ether applied in constant stream in a quantity sufficient to keep the gauze saturated as shown by dripping.

Time	Ether Per Cent.	Amount of Ether	Temperatures of inspired air								Notes
			I	II	III	IV	V	VI	VII	Bath	
4.07	Started	.....	..	..	..	..	..	..	..	..	
4.10	29 (leak)	.....	10	14	..	25	26	29	30	38	
4.16	29 (leak)	.....	..	..	..	..	..	..	..	..	
4.25	36 (leak)	Stopped	10	15	..	27	27	31	33	39	Increase by stopping leak.
4.30	40 (on)	.....	..	..	..	..	..	..	..	..	

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breather is as great experimentally as it is in actual practice. The third experiment cited in Table 1 illustrates the tremendous amount of ether that must be poured on the mask to bring 24 liters or air per minute up to 30 per cent.

The words "on" and "off" after the percentages indicate the advantages to be obtained from a little anesthetic trick that deserves better recognition: namely, the greater ether percentage that can be obtained by placing the hands on the mask; the warmth of the hand aids the vaporization of the ether as well as preventing a leakage of air around the bottom of the mask. In practice I put a hand on one side of the mask and drop the ether on the exposed side, reversing sides about once a minute.

The fourth experiment shows the higher percentages obtained when the "dummy" breathed less deeply (12 liters per minute). A smaller amount of ether was needed and the higher percentages were far more easily obtained. The effect of preventing a small leak around the "nose" is strikingly shown.

These experiments explain away the apparent contradiction between the clinical fact that large, vigorous people, especially if alcoholic, need a great quantity of ether to produce anesthesia, and the physiologic law that all persons require the establishment in the body of approximately the same tension of ether vapor to produce the same depth of anesthesia. A recognition of this fact transfers the blame for a difficult and bad ether from the patient to the technic and ability of the anesthetist.

The question of the loss of heat directly attributable to the administration of the anesthetic mixture during an operation is one of importance. If there is an undue loss, effort should be made to prevent it; on the other hand, if the loss proves to be comparatively small and therefore negligible, attention should be directed to more efficient and natural means of conserving the body heat.

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The complete calculation is given in Table 2. It is evident that a loss of about 3½ calories per hour can be attributed directly to warming the ether, and an equal amount of bringing the temperature of the air itself up to body temperature. This makes a total of 7 calories; Vierordt assigns 4 calories as the normal amount.

TABLE 2.—CALCULATION OF AMOUNT OF HEAT LOST BY RESPIRATION DURING ETHER ANESTHESIA

(Open wire mask with 16 layers gauze.)
Assumptions (based on experimental evidence):
Vol. of respired mixture (average): 10 L. per min., 600 L. per hour.
Containing: ether (average): 16 per cent., 96 L. per hour = ¾ lb. approximately.
Containing air (average): 84 per cent., 504 L. per hour.
Temperature of mixture as inhaled at mouth: 15 C.
Physical data:
Liter weight of ether: 3.53 gm. Specific heat of ether: 0.4796.
Liter weight of air: 1.29 gm. Specific heat of air: 0.2374.
Formula used:
Vol. × L. Wt. × Sp. Ht. × Deg. = Gm. calories lost.
Calculation.

Ether:	96 × 3.53 × 0.4796 × 22 = 3575 gm. cal. =	3.6 calories.
Air.	504 × 1.29 × 0.2374 × 22 = 3395 gm. cal. =	3.4 calories.
		7.0 calories.

Careful consideration of all factors involved shows that there is practically no change from the average loss of heat by the vaporization of water from the lungs.

Vierordt gives the following average values of heat elimination:

	Daily Cal.	Hourly Cal.	Per Cent.
1. By urine and feces	47.50	1.98	1.8
2. By expired air: (*a*) warming air	84.50	3.52	3.5
(*b*) vaporization of water	182.12	7.59	7.2
3. By evaporation from the skin	364.12	15.18	14.5
4. By radiation and conduction from the skin	1,791.82	74.65	73.0
	2,470.82	102.92	100.0

It is more difficult to estimate the amount of heat eliminated through evaporation of water in the lungs. A consideration of the following facts leads to the conclusion, however, that little, if any, variation from the normal occurs. The points to be considered are:

1. The mask contains an excess of moisture due to the deposit thereon of the water normally eliminated by the lungs on expiration.

2. The room air at about 20 C. (68 F.) and from 60 to 70 per cent. saturated falls to an average of 15 C. (60 F.) in the presence of an excess of moisture. There-

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fore little if any change can take place in the total amount of moisture in the inspired air; consequently the loss of heat by vaporization will not be materially affected. The only possible increase in elimination, so far as I can see, would be during the stage of induction, at which time the respirations are increased in rate and depth through the stimulating effect of the ether. In the weak and debilitated, however, in whom an increase in heat elimination is of importance, the respiration is as a rule little affected and, therefore, only small amounts of air and ether must be warmed and saturated with moisture.

Reference to Vierordt's figures at the bottom of the table will show that the normal elimination of heat by the lungs totals about 11 calories.

During ether anesthesia it cannot at the outside be more than 16 or 17 calories, or an increase of 5 or 6 calories.

To contrast with these figures we must consider the amount of heat eliminated by the skin in the same period. Vierordt gives for this an average of 90 calories an hour. The danger to the patient of losing an undue amount of heat from the skin by evaporation, radiation and conduction is far greater than can take place from the lungs.

The conclusion seems inevitable that our attention should be directed to keeping the patient dry and warmly covered, and not to the procedure of warming the anesthetic mixture. Such warming of the inspired air is futile from the point of view of thereby sufficiently preventing a lowering of the body temperature during a surgical operation.

SUMMARY

I. 1. Apparatus and experimental details are given for determining the ether percentages that are obtained by passing air over liquid ether.

2. The advantage of keeping the liquid ether warm is demonstrated and the beneficial action of the pro-

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cedure explained by showing the effect on the ether percentages obtained and the want of effect on the temperature of the inhaled mixture.

II. 1. A new method of determining the percentages of ether vapor and the temperature of the inspired mixture as obtained from a mask is described. The method used is considered to give results comparable to the percentages and temperatures existing in actual clinical etherization.

2. Clinically it is known that large, vigorous (alcoholic) patients require a great quantity of ether poured on the mask to produce anesthesia. Physiologically it is recognized that essentially the same tension of ether vapor in the body produces in all subjects the same depth of anesthesia. It is pointed out that the clinically difficult cases are those in which the patients are deep breathers, those whose volume of air respired averages over 20 liters instead of below 10 liters per minute. The apparent discrepancy between clinical experience and the physiologic law, therefore, consists in the difficulty of the anesthetist in bringing such a large volume of air up to the percentage of ether required. In short, the anesthetist and not the patient is to blame for a difficult and bad ether.

III. From a calculation of the loss of heat directly attributable to warming anesthetic vapors, it is demonstrated that such loss is negligible in comparison to that from the body surface. Consequently it is futile to warm the anesthetic vapors.

508 Commonwealth Avenue.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. HERB, SLOAN, PECK, MITCHELL AND BOOTHBY

DR. CARROLL W. ALLEN, New Orleans: As early as 1889 Dr. Matas introduced a method for reaching the second division of the fifth nerve by passing the needle into the orbit, hugging the bone at the lower external angle and directing the needle slightly inward. It enters the sphenomaxillary fissure, passes backward a distance of 5 cm., in the orbit of an adult, and then is exactly under the foramen torundum. I have used

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this method for blocking the second division of the fifth nerve. I have had ten or twelve cases in which the entire jaw was removed. When the needle is passed 0.25 cm. further back, it reaches the third division of the nerve The methods introduced by Offenhaus and by Härtel exemplify the more notable progress made in this field lately. Härtel produces a small area of anesthesia on the cheek and introduces a needle about 5 cm. in length upward, forward and backward.

Dr. Karl Connell, New York: I believe that the use of alkaloids before anesthesia is entirely unnecessary unless one is using an anesthetic like nitrous oxid. I do not believe that nitrous-oxid-oxygen anesthesia is preferable to ether. The results, so far as Gwathmey and I have gone, show quite the contrary. The ether blocks shock far better than pure nitrous oxid. Intratracheal anesthesia is one of the most highly advanced methods now in use. It causes beautiful oxygenation, carries the patient without shock and permits positive pressure, if desired, and the highest degree of artificial respiration; but the chief advantage in the average case is that it permits one to carry the anesthesia absolutely on the lowest percentage for that particular person and that particular type of operation. As Dr. Boothby said, one can carry along the anesthesia for hours, possibly days. Ether percentage has come to be an important factor in giving an anesthetic, because it is desired not only to put the patient to sleep promptly, but to keep the patient asleep for as long a time as necessary, even hours, with the use of a minimum amount of ether. The level, as it is called, should be maintained in every case. When the operation is completed, the patient should wake up promptly; in fact, he should be practically out of the anesthesia.

Dr. Evarts Graham, Chicago: We have learned that ether is perhaps indirectly responsible for some of the various postoperative or postanesthetic complications with which we are familiar, such as thrombosis, embolism, various lung complications, shock and acute dilatation of the stomach. It should be further desirable to attempt to devise an arrangement by which the ether will maintain its toxic action on the body the shortest possible time. This concerns also the problem of elimination of ether. Even after a short ether anesthesia the smell of ether may be detected in the breath of the patient for a number of hours afterward, so that even under ordinary circumstances ether is slowly eliminated from the body. Now, if we desire to increase the rapidity of elimination of ether from the body, we must consider first of all the channels by which it is normally eliminated. Ether is eliminated in large quantities through the lungs. It also gains entrance to the alimentary tract. The vomitus even after a short anesthesia smells strongly of ether. The ether also escapes through the

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skin, and part of it gets back into the alimentary tract and is reabsorbed. A period of hours is necessary to eliminate all of the anesthetic from the body. If we can step in somewhere on this circle and drive out the ether in some other way than occurs naturally, we may prevent some of these distressing postoperative complications. The fact that ether is more soluble in fat than it is in water is evidence that such a process can occur; by placing fat in the alimentary tract we can hold the ether there and prevent its absorption from the intestine. If two dogs of the same weight are given through a stomach-tube the same amount of ether, in one case diluted with the same amount of water, and in the other with an emulsion, the dog which receives the ether and water, if it does not vomit up the mixture, becomes deeply anesthetized, often sufficiently to kill it, whereas the dog which receives the mixture of ether and fat not only does not vomit, but is in no wise affected by the ether. This shows conclusively that the fat has prevented the absorption of the ether. Advantage has been taken of this fact in the clinic. For the last year or two I have administered fat in tne form of olive oil after the anesthetic was stopped. I found that not only is the post-anesthetic period shortened, but there is also less vomiting, in spite of the statements to the contrary which one occasionally finds in the literature, based on mere conjecture and not on experimental proof.

Dr. Harry G. Sloan, Cleveland: The experiments carried out by Crile and Prendergast were as follows: Ten dogs were taken in each of two groups. The first ten were given ether, and shock was produced by rubbing the peritoneum for three hours. The second group were given nitrous oxid, and shock was produced in the same manner as in the first group. Blood-pressure tracings were taken to determine the reaction. The ether dogs showed at the end of three hours an average blood-pressure of 10 mm. of mercury, whereas the nitrous oxid dogs showed a pressure of 110 mm. of mercury. Surely a great difference! The ether was given by the open drop-method, not the intratracheal method. I do not see that there is any great difference in the method of administration, for anesthesia occurs only when the blood-stream contains a certain percentage of ether. In shock, the brain transforms its latent energy into nerve impulse in response to traumatic stimuli; its cells become exhausted. Ether anesthetizes by lipoid solution. Nitrous oxid anesthetizes by inhibiting the intracellular use of oxygen, so that we have two directly contrary principles at work. Under nitrous oxid the functional activity of the nerve-cell is curtailed; hence exhaustion is much more slowly reached than under ether when oxidation is normal.

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THE EXTERNAL BONE CLAMP VERSUS THE INTERNAL BONE PLATE IN THE OPERATIVE TREATMENT OF FRACTURES

LEONARD FREEMAN, M.D.
DENVER

So much has been said recently about Lane's internal bone plates that there is danger of losing sight of the advantages of the external bone clamp. Hence a brief comparison of the two should be of interest.

In operating on fractures it is often necessary to employ some artificial means for holding the fragments in position. According to circumstances this may be done with chromic catgut, wire, bone or ivory ferrules or medullary plugs, autogenous or heterogenous bone grafts, staples, internal bone plates, or external clamps of various patterns.

The ideal method would consist in the use of something which, while holding the bones firmly and not irritating the tissues, would rapidly undergo absorption, thus leaving no foreign body to cause delayed union and late infection. It should also be easy of application, with the least traumatism, and should not interfere with the process of repair.

Unfortunately none of the procedures in use fulfil all of these requirements, although most of them answer sufficiently well in appropriate cases. At present the plate and the clamp are most in favor, although, in ununited fractures at least, the autogenous bone graft is rapidly gaining ground and may soon supplant both of them.

Great similarity exists between the internal plate and the external clamp. Both are fastened to the bone with

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the same number of screws, the only difference being that in one the part which unites them is outside the skin, while in the other it is beneath it. In fact, the clamp might be termed an external plate or the plate an internal clamp.

All external clamps have in common several screws, long enough to project well beyond the skin when they are inserted into the bone. The many varieties differ only in the mechanism by which the screws are held together.[1]

The advantages of the external clamp over the internal plate, in appropriate cases, are:

1. It can often be more easily applied, with less manipulation of the tissues and denudation of the bone. Holes can be drilled and the screws inserted with the fragments in almost any position. They can then be adjusted without the use of elaborate holding-apparatus and the screws instantly clamped (see illustration).

2. Nothing comes in contact with the line of fracture, as does an internal plate; and the screws themselves may be placed as far away from the break as may seem desirable—even in sound, uninjured tissues. This is of much importance, because, as is well known, the presence of a foreign body favors delayed or non-union, to say nothing of infection. In this connection Martin[2] says, "As a rule, the presence of a plate, instead of stimulating osteogenesis between the broken bone-ends, retards it." The possibility of placing the screws at a distance from the fracture is also of manifest advantage in cases in which the bone is comminuted.

3. In most instances an external clamp will immobilize the bone fragments even more firmly than an internal plate will, as may easily be demonstrated. This is because the long screws get a particularly firm grasp within the bone and the heavy external clamp holds them together with absolute security. The screws, if

1. The external bone-clamp was introduced into this country and popularized by Clayton Parkhill of Denver.
2. Martin: Surg., Gynec. and Obst., September, 1912.

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rigid enough, may be long without detriment, because they will be removed later; and the clamp may be heavy because it lies without the tissues. When a clamp is properly inserted, say in a fracture of the tibia or of the femur, the limb may be picked up by the foot and thrown about in any direction without fear of disturbing the fracture; but if a plate is employed this can seldom be done without danger of bending or breaking it, or of pulling the screws from the bone.

4. The principal advantage of the external clamp, however, is that it may easily be removed at any time without the use of a general or even a local anesthetic, thus avoiding a much-dreaded secondary operation and also the necessity of leaving a foreign body in the tissues with all the disagreeable possibilities that this implies.

Every one knows that while plates are being inserted all over the country, they are constantly being taken out, either by those who put them in or by others. If this were all it would not be so bad; but, in addition, sepsis is not infrequent, sometimes resulting in loss of limb, as I have seen, or even in loss of life. In our Denver hospitals, which, I venture to say, compare favorably with most others, many plates have been inserted, the majority of which have had to be removed for various reasons, and some of the results have been disastrous in the extreme.

Let us now consider some of the disadvantages urged against the use of the external clamp:

1. Its size and weight. This objection is easily disposed of. The large and heavy portion, which insures security and strength, lies outside, where it is productive of neither inconvenience nor danger of any kind—a large instrument being tolerated by the patient as easily as a small one. The screws alone penetrate the tissues, and they are often of no greater diameter than those of an internal plate.

2. The most plausible objection to the external clamp is the supposed great danger of primary or secondary

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infection. This has been frequently and strongly urged, but, I am convinced, without adequate reason. The situation may be put in a few words: If the operation is a clean one primary infection will not occur with clamp or plate. If the operation is not clean, infection may take place with either; but its effects will be less severe with the clamp, because of drainage afforded by the external screw-holes. And on the side of the clamp lies also the great advantage that it may easily be removed at any time without a second operation.

If secondary infection occurs with the external clamp, it is late in appearing, trivial in amount and confined strictly to the screw holes, as has been amply proved by the experiences of Parkhill, Lambotte, myself and many others. In fact such localized, non-spreading, secondary infection may be compared to that which is seen around sutures of silkworm-gut, although infection is more likely to take place in connection with sutures than with screws, on account of constriction of the tissues by the former.

Infection does not easily spread with either screws or sutures because a granulating channel is soon formed which affords a protecting wall against bacterial invasion. In order to elucidate this point more clearly some experiments were conducted on dogs by my associate, Dr. O. S. Fowler. By inserting screws through the soft parts into the bones he was able to demonstrate that the holes become lined with granulations in the course of three or four days (the specimens were examined by Dr. Philip Hilkowitz) and it is not unlikely that a certain degree of protection begins even earlier. Secondary infection, however, really does not occur until much later than this, if proper precautions have been taken, thus giving ample time for the walling-off process to become complete. On occasion I have left clamps in place for from two to four weeks without manifest infection, and others have had similar experiences. During this period considerable protection is undoubtedly

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afforded by loose dressings, which favor rapid drying of the secretions, and by the occasional application of alcohol or of weak tincture of iodin to the vicinity of the screw-holes.

3. It is said that external clamps are difficult to use in certain cases. This is undoubtedly true, especially near the ends of the long bones, where the terminal fragment is too small or the cancellous tissue too soft for the screws to obtain a sufficient hold.

The whole question may, I think, be fairly epitomized as follows:

Both the plate and the clamp have their legitimate uses. In the hands of surgeons especially skilled and experienced in work of this kind, like Mr. Lane, for instance, plates may be more or less successfully employed at will. With the great majority of surgeons, however, the external clamp, when practicable, should be the instrument of choice, although there will always be those who will prefer the plate, in order to demonstrate their ability to use it.

The external clamp is especially indicated in connection with the shafts of the long bones, when the fracture is not too near the epiphysis or too deeply situated, as in the thighs of extremely fleshy or muscular individuals.

It almost goes without saying that clamps should always be employed in preference to plates in compound fractures where there is danger of infection resulting from the injury. It being a foregone conclusion that whatever is put in will have to come out again, it seems purposeless to use something which cannot be removed without a special operation and which adds to the danger of sepsis by its proximity to the line of fracture and by its size.

Metropolitan Building.

ABSTRACT OF DISCUSSION

DR. JOHN B. MURPHY, Chicago: The subject of treatment of fractures is, at this particular time, paramount in our surgical clinics. The proposition of doing an open operation

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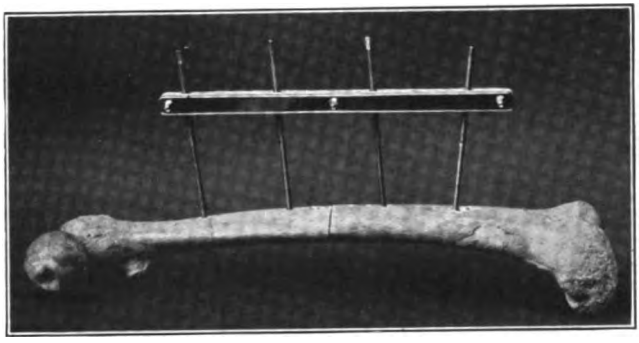

External Bone Clamp.

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for a fracture is much more serious than is the proposition of opening the abdomen, because you are dealing with tissues which while not so dangerous to life if infection does occur are enormously more easily infected. If a man can do an open operation for fracture and obtain aseptic healing, with regularity, he is doing the ideal thing. The control of the possibility of infection, however, is not always in his hands. There are many conditions that contribute to the occurrence of infection in the reduction of the fracture and its permanent fixation, and I am pleased to know that the doctor is endeavoring to get an accurate and perfect apposition by means of a device that does not expose the line of internal laceration and the fracture to infection. The Lane plate is the ideal means, to my mind, of holding together mechanically the fragments of the bone, provided it is placed by a man who is a master of the technic and who always attains perfect asepsis. There is still another element, however, in the management of fractures that is being overlooked. Why is it that we are having ten, fifty, one hundred cases of non-union of fractures to-day, where we had only one in the decade from 1885 to 1895. My interpretation of that is that in the modern management of fractures with, first, the plaster cast; second, the Lane plate and, third, the instruments and appliances that absolutely immobilize the line of fracture there is not sufficient irritation to stimulate osteogenesis at the line of fracture. We have failed to learn what the Germans learned when they began to use plaster casts. The German surgeon, after applying the cast, starts his patient as an ambulatory case. He moves around and there is sufficient stimulation of the ends of the fragments to favor osteogenesis and healing of the fracture. The American surgeon, as a rule, puts on a plaster cast and confines the patient to bed for from five weeks to five months, and at the end of that time he is surprised to find not even the slightest effort at regeneration of the bones. Mr. Lane during his last visit in this country emphasized the fact time and again that the Lane bone plate should not be used in cases of non-union. He recognizes the fact that there is something in connection with the fixation of the fragments that retards or at least does not stimulate osteogenesis in non-union cases. Another point which I was glad to have Dr. Freeman mention, because it is a most important one, is putting foreign bodies into compound fractures. If we could only learn to keep our hands, our nails, our screws, our spikes and our bone-splints out of fractures that are in all probability already mildly infected, we would have much better results in the treatment of compound fractures. After swabbing the surface with iodin solution, a dressing of gauze soaked in alcohol should be applied and the whole limb immobilized for many days unless the temperature or other conditions indicate a change.

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DR. L. L. MCARTHUR, Chicago: Heartily in favor as I am of the recommendations of Dr. Freeman, I want to emphasize the fact that the statement is not correct that a limb cannot be handled after the use of a plate, whereas it may be handled after the use of the apparatus he described. Having just returned from the Canal Zone, where the opportunities for the treatment of fractures have been surrounded by more difficulties than in any other portion of the world, I want to say that they have found there that the introduction of the Lane plate makes it possible for them to treat the terrible cases of fracture they have had. These fractures are the result of dynamite explosions and crushings; they are usually compound, and these Lane plates have been put on every one of them. I saw 210 roentgenograms of cases that had been plated, and every one showed that a plate can be used in these fractures with good results, and in such a climate as that the plaster-of-Paris cast cannot be used because it becomes limp in a week. Therefore we must not conclude that the bone plate applied in a dirty wound will not enable us to handle the limb like a simple laceration of soft tissues. It can be done.

DR. A. E. HERTZLER, Kansas City, Mo.: I wish merely to throw out a few points as to why non-union occurs when a Lane plate or any other metallic appliance is used. The first step in wound healing is the precipitation of fibrin in the exudate, and anything that prevents that from occurring, prevents healing of the fracture. That is the whole problem. When a piece of metal is placed in a tissue a large amount of exudate is formed which does not coagulate readily or may remain permanently in a fluid state. Different metals act in slightly different ways. Silver produces more of an exudate than any other metal I have tested. Aluminum bronze produces the least. The problem in using a plate is to prevent the collection of this exudate. The best means for doing this is to provide drainage, so that the fluid can escape, or to place the plate in a tissue the least likely to produce exudate. For instance, in the thigh, in which there are large pads of muscles, more of this fluid collects than in the leg. For the same reason less fluid collects on the anterior surface of the tibia than on the external surface. Therefore the plate should be placed in the subcutaneous connective tissue rather than in the muscle bed when this can be done. If we are forced to use a splint where there is much muscle tissue, with the attendant abundant exudate, non-union will occur less often if the excess of exudate is drained away from about the plate until the ends of the bones not in touch with the splint have had time to become imbedded in fibrin—about forty-eight hours.

DR. CARROLL W. ALLEN, New Orleans: Dr. Parham has a method which is particularly applicable in the treatment of spiral or comminuted fractures with which it is not neces-

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sary to place a clamp on by screws or to use a nail through an oblique fracture. The instrument consists of two parts: (1) a metal band one-fourth of an inch in width with one end expanded and containing a slit through which the other end is slipped, making a loop; and (2) an apparatus consisting of a screw-rod, working on the principle of an écraseur. between two parallel steel bars for the purpose of drawing up the band and tightening it. In applying the band this is first placed around the bone at the site of the fracture with the oblique fragments adjusted, and one end is slipped through the slit at the other end and then attached to a hook on the screw-rod in part two. The screw is then worked, drawing up and tightening the band around the bone. When it is sufficiently tight the instrument is bent over causing the band to be bent on itself and clinching it. The band is then cut off close with a pair of pliers and the instrument removed.

DR. LEONARD FREEMAN, Denver: You will remember that my plea was not for the universal use of the clamp in preference to the plate, but merely for its more frequent use in suitable cases. Dr. McArthur has made me say that a fractured limb could be picked up by the heel when a clamp was used, but not where a plate was employed. What I really said was that the limb could be picked up just as well when the external clamp is applied, as when the internal plate was used, and perhaps better. He said that in Panama many metal plates were put in. It would be more interesting to know not the number of plates put in, but the number of plates that have had to be taken out afterward. The number is probably considerable. Dr. Hertzler spoke of the reasons for non-union and insisted that drainage would be desirable. This is obtained with the external clamp. One of the main reasons for non-union when the internal plate is employed is that the metal comes in contact with the line of fracture. With the external clamp there is no metal in contact with the line of fracture, or, of necessity, anywhere near it.

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THE ADDED RESPONSIBILITY OF THE SURGEON WHEN CALLED ON TO TREAT SURGICAL LESIONS IN THEIR EARLIER STAGES

JOSEPH COLT BLOODGOOD, M.D.
BALTIMORE

The easier the diagnosis the worse the prognosis. This statement hardly needs further comment or illustration. It is especially true in malignant disease. When the surgeon is able to recognize cancer by its clinical appearance the relative prognosis is bad. Complete operations in this stage yielded 30 per cent. or less of permanent cures.

When the malignant disease cannot be recognized clinically because of its early stage, but is diagnosed at the exploratory incision by its gross appearance, with or without the aid of a frozen section, the prognosis for an ultimate cure is best, provided the complete eradication of the disease immediately follows the exploratory diagnosis. My investigation of the statistics up to date seems to show that the probabilities of a cure are at least 80 per cent. This, of course, varies with the position of the lesion.

If at this exploratory incision however, the malignancy is not recognized and a piece of the lesion is removed for diagnosis, or even when the entire local lesion is removed with a narrow margin of healthy tissue, and then, later, after the microscopic diagnosis, the complete operation is performed, the probability of a cure is distinctly less than after a complete operation in a later stage when the diagnosis can be made from the clinical symptoms.

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From an investigation of the material recorded in the laboratory of the Johns Hopkins Hospital Surgical Clinic, this statement can be made with certainty. So far as my personal experience goes, it is incontrovertible.

We may safely state therefore, that in the earlier stages of surgical lesions the diagnosis is the major part of the surgery; the operation is minor. It is expert and delicate surgery, nevertheless, and the immediate and ultimate results are the best. In this stage treatment is the test of the diagnostic technic.

In the later and latest stages of the surgical disease the diagnosis becomes the minor part, the operative surgery the major, and the results, both immediate and permanent, are worse. Here we have the test of operative technic.

The more one investigates critically the ultimate results of diseases subjected to surgical treatment, the more one becomes impressed with the fact that surgery in the hands of the majority of operators is usually a little behind the disease.

In the early stages the clinical manifestations are so slight, and the lesion seems so insignificant, that even when the diagnosis is correctly made, the relative "favorability" so impresses the surgeon that he is very apt not to do enough. If he unfortunately makes a mistake in diagnosis the result is even worse.

In the later stages of the disease the apparent hopelessness of the condition checks his enthusiasm to be radical, and here again he often fails to accomplish the possible cure.

This investigation of the ultimate results in relation to the stage of the disease, its diagnosis and treatment, demonstrates that there is room for improvement in both. The investigation should have for its object the development of a method of recognition and treatment which will allow a surgeon to be ahead of the disease, and thus increase the number of permanent cures in every stage. There is no doubt that the best opportunity

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for a cure is in the early stage, but we have sufficient evidence to demonstrate that in later stages more radical procedures properly performed under improved anesthesia and technic have accomplished permanent cures, and there is no reason why these should not be increased in number.

We must not rest satisfied with our results. We must not continue to follow any routine method of diagnosis and treatment, unless it is constantly controlled by the evidence of the ultimate condition of the patient.

How few surgeons in this country really know their immediate mortality, which is evidence most easily obtained. Fewer still have a comprehensive and accurate knowledge of their ultimate results, evidence more difficult and costly to obtain.

METHODS OF DIAGNOSIS

In brief, our available methods of diagnosis are not always employed. The clinician usually neglects laboratory tests; the strictly laboratory diagnostician does not put sufficient stress on the clinical investigation. There is no doubt that in many instances we are handicapped, especially in the early stages of the disease, by an absence of clinical evidence and by lack of an exact laboratory method, and in some cases the exact laboratory method may have an element of danger. For example, in the majority of cases the excision of a small piece for microscopic diagnosis has an element of danger. In malignant disease it seems to increase the probability of dissemination. We may be able to develop a technic which can reduce or eliminate this danger. In my own experience such an exploration should never be done except in special cases. In cases in which the local and complete excision of the visible and palpable lesion would be unnecessary, mutilating and dangerous if the lesion were benign, we may be compelled, in a few instances, to excise a piece for diagnosis. In such cases the excision of a small piece should be followed by the

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cauterization of the wound. The electric or Paquelin cautery is best. If the microscopic diagnosis shows that the lesion is malignant, the necessary operation should follow as quickly as possible.

In this paper I cannot go into the detail of the methods of clinical and laboratory diagnosis for the different lesions in the different localities, but when I discuss these different lesions I shall be able to call attention briefly to the more important facts.

CLINICAL DIAGNOSIS

When one investigates a large number of clinical histories of any of the different surgical lesions, he is at once impressed with the difficulty of recording the clinical manifestations successfully and in detail. This is especially true when we have before us the problem of estimating the minimum symptoms of any disease which justify surgical treatment. Most patients come under observation in the later stages: the maximum symptoms are present; the diagnosis is not difficult; the indicated operation is generally clear. As stated before, however, we should not be satisfied with either the immediate or permanent results of treatment in this stage. Now, when we come to investigate these histories and look for the recorded statements of the symptoms of the disease in its beginning, they are either conspicuous by their absence, or too meager to be useful.

This state of affairs is undoubtedly due to the fact that the patient is chiefly impressed with the symptoms from which he suffers at the time of examination and treatment, and often does not remember the symptoms of the beginning of the trouble. In addition, the mental horizon of the surgeon and his assistants seldom extends beyond the present state of the disease. Their interest is concerned chiefly with the diagnosis and treatment of the disease in its present state. This, of course, is of the utmost importance. The patient seeking help demands relief; he cannot be put back into the

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beginning of the disease; he must be treated at the time when he first seeks help.

The majority of us fail, nevertheless, to recognize that a clinical history which carefully records all the possible etiologic factors, the symptoms at the beginning of the trouble and the development and picture of the clinical course, as well as the present condition, is not only of added value for the diagnosis and treatment of this patient, but, in addition, leaves a record which, when multipled by many others, allows us to picture this disease in its beginning and to formulate the minimum of symptoms, so that when patients fortunately seek advice and help in the beginning or the earlier stages we shall have prepared ourselves for that recognition and appropriate treatment which will yield the best immediate and permanent results.

At present so few patients seek advice in the early stages that we must depend on the clinical investigation of the larger group who come under our observation in the later stages for the evidence of the clinical picture in the earlier stages.

The more evident the symptoms and the easier the diagnosis, the worse the clinical history of the early stages. We must recognize that the more careful and elaborate clinical records of cases of this type are of the utmost importance for our own education and development and for the benefit of our immediate and future patients. In time of peace prepare for war. In this period of the treatment of disease in its later stages, we must prepare ourselves for the diagnosis and treatment of the disease in its very beginning and earlier stages. At present the educated patient who seeks help early is rare, but will be increasing in numbers, and we must prepare ourselves for the added responsibility.

The taking and recording of these more elaborate histories require a larger number of assistants. At present hospitals connected with medical schools are better prepared to meet these greater requirements. The third-

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year and fourth-year medical students can be taken into the wards as clinical clerks. In the experience of the Johns Hopkins Hospital, the records have been much better since students have been admitted to the wards. At present a patient in the ward is more carefully investigated than a private patient. There is no reason why the students should not be assigned to the private wards also.

A clinical history cannot be taken at one sitting. In emergency cases, when we are confronted with the urgency of immediate diagnosis and treatment, we should take only the time necessary for immediate diagnosis. The patient should not be fatigued by a prolonged interview. After the operation the clinical record can be completed. In chronic cases the history should be taken two or more times. All histories should be checked by the more experienced senior surgeon, and should be added to from time to time, when the patient is written to as to the ultimate results.

For a number of years I have been retaking the history of patients who have returned to the hospital for examination, and I have been surprised at the frequency with which additional important data have been obtained.

A clinical record, therefore, has two distinct functions: first, and most important, for the needs of the patient; second, an elaborate and accurate record which, when multiplied by many others, will be valuable for the investigation of the etiologic factors and the minimum of symptoms of the earliest stage of the disease, so that we can educate people to seek advice in this stage, because we know even now that treatment in this stage yields the best immediate and permanent results.

LABORATORY DIAGNOSIS

No matter how exact the science of medicine may become in its diagnosis with methods of precision, the art of medicine, which rests on the clinical investigation and deductions, should never be neglected. Laboratory

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investigation requires a different training, but much of this is available for any physician. Some must be delegated to experts who give their entire time to this department. The time is not far distant when special laboratories for these methods of diagnosis which will be available to all physicians in the different parts of this country will be established.

At present the easier and more available laboratory methods of diagnosis are not employed as a routine, but only in special cases. The more my experience grows, the more do I become convinced that many of these tests should be employed as a routine procedure.

The Wassermann test for syphilis and some exact test for tuberculosis as a routine procedure would be a benefit not only to the patient but also to the community.

The ordinary examination of the urine is usually made, but the test for kidney function has become a routine practice in but few, if any, clinics. My experience teaches me that this test is one of the most important in the estimation of the vital resistance of the patient before operation.[1]

In bone lesions the test for Bence-Jones bodies is usually neglected. Undoubtedly other methods of precision will be developed in the examination of the urine. The test for pancreatic function is at present not conclusive. The examination for diacetic acid and acetone should be a routine procedure before, as well as after operation. In non-diabetic cases its presence indicates that the patient needs more food; in some cases, without this check, we may restrict food too much before and after operation. It is the most valuable test in diabetes.

A complete blood-count with a differential count of the leukocytes should seldom be neglected in the investigation before operation. There is no space here to discuss the importance of anemia and the changes in the number and character of the leukocytes as a help in

1. Bloodgood, J. C.: Estimation of Vital Resistance of Patient with Reference to Possibility of Recovery, Ann. Surg., May, 1912.

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diagnosis and treatment. The estimation of the blood-pressure before, during and after operation is becoming a routine procedure.[2] The literature shows the growing interest in this instrument of precision.

The roentgenograph and the Roentgen fluoroscope have taken such an important place in laboratory investigation that I need not take space here to discuss them. To develop the interpretation of this laboratory method one should repeatedly bring together the roentgen-ray findings before operation and the picture found at operation. Unfortunately at present the one who takes the roentgenogram seldom sees the operation, and the one who operates looks but casually at the plates. The surgeon has as much to learn by the comparison of his roentgenograms and the operative findings as the roentgenologist. Both are making unnecessary mistakes by neglecting the observations of the other.

The microscopic picture of the removed disease is investigated chiefly by the pathologist who as a rule is given meager, if any, opportunity to know the clinical symptoms, while the surgeon rarely adds to his knowledge of the disease by a personal study through the microscope.

No surgeon can devlop the diagnosis of surgical diseases by their gross appearances when exposed at the operation without the aid of the microscope. He does not realize the importance of this, because in at least 90 per cent. of benign and malignant lesions the patient seeks advice when the diagnosis can be made clinically. The surgeon is therefore able to perform the operation with a large amount of certainty without the aid of either the gross appearance or the microscopic sections; but when the remaining 10 per cent. of patients present themselves to him he finds himself handicapped. He then seeks the help of the pathologist who is equally handicapped, because of his lack of familiarity with

2. Railway Surg. Jour., 1913, xix, 459.

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the clinical manifestations. Both make mistakes because their education is incomplete. The surgeon expects too much of the pathologist; many pathologists are too certain of their frozen-section diagnosis.

As a matter of fact, the surgeon has a better opportunity to develop the diagnosis of benign and malignant lesions than the pathologist, because he comes in contact with the clinical manifestations in an entirely different and more intimate manner. After the complete removal of the clinically diagnosed disease he has the opportunity to cut into it; to observe its gross appearance; to educate his sense of touch with the finger and the knife, and to examine it alone, or with the pathologist, under the microscope. In this way he can train himself to recognize those ten cases out of a hundred in which the diagnosis cannot be made clinically, but must be made immediately by the gross appearance at the exploratory operation with or without the aid of the frozen section. He and the pathologist must know when a frozen section can be depended on for diagnosis and when it cannot. The responsibility, however, rests with the surgeon. He should seek all possible help, but he cannot divide the responsibility, and he should know what to do when in doubt. This differs with lesions in different localities. In breast tumors, when in doubt, perform the operation for cancer, in bone tumors be conservative.

We have sufficient evidence now, evidence that is easily available and will allow the surgeon, if he has investigated the clinical and laboratory records, to know what is best to do for the patient and to prepare himself for the added responsibilities when called on to treat surgical lesions in their earlier stages.

The routine examination of the stools for parasites to explain anemia is usually neglected, nor is blood often looked for, and I am surprised that frequently the general practitioner and even the interns in the hospital fail to examine the stools in cases of slight jaundice.

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The presence or absence of bile in the stool is of the utmost importance in the history and examination of biliary cases.

Surgeons who are keen on abdominal palpation usually neglect percussion and are very shy on the routine examination of the chest. The roentgenograph, of course, is an instrument of precision for lesions in both the chest and the abdomen, but we have by no means developed our instruments of precision for the examination of the heart, except for the estimation of the blood-pressure. We shall have to wait for the results of the clinicians as to the value of the electrocardiograph.

Routine examinations of nose and pharnyx are now being made in many hospitals, but this is still an often neglected field. The ophthalmoscopic examination of the eye is at present employed only in selected cases.

Enough has been said to demonstrate that with the aid of the available methods of clinical and laboratory diagnosis fewer mistakes should be made, and that even in the earlier stages of surgical diseases accurate diagnosis is possible. At present we should not so much call for newer methods, but should employ in every case those that are well established.

The majority of mistakes in diagnosis are due not to poverty of methods, but to neglect or ignorance of well-established clinical and laboratory tests.

For example, a patient consulted me some months ago for epigastric pain which had been present three years; it was entirely subdiaphragmatic; not only was it present in the epigastrium, but it also extended to the right and left; it was rarely absent; at times it was more intense; there were absolutely no other symptoms. The patient had consulted many physicians; he had been to many institutions for treatment. Every one whom he consulted apparently looked on the case as one of indigestion and without further examination prescribed a diet. He had taken a number of treatments in this country and abroad. I told him that he had had

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three thousand dollars' worth of treatment, and not one cent's worth of diagnosis. I sent him to the hospital, where all the routine clinical and laboratory investigations were made. Clinically we could get from the patient only the statement as to his epigastric pain and the loss of weight. He denied luetic infection. The only laboratory test that was positive was the Wassermann. He was then given salvarsan. In two weeks the pain disappeared; in one month he had gained 18 pounds.

In the past year I have had referred to me three cases diagnosed clinically as sarcoma of bone. These patients had been treated with Coley's serum, but refused amputation. In each case no Wassermann test had been made. In each case I found this reaction to be positive, and the periosteal swellings disappeared under salvarsan.

In 1904 I discussed this subject of the diagnosis of surgical lesions in their earlier stages[3] and presented the question more thoroughly in an address[4] before the Lehigh Valley Medical Association in July, 1911.

I have been impressed for years with the fact that surgical technic has advanced more rapidly than surgical diagnosis, and that surgeons, from their accumulated records, should present to the medical profession the minimum of symptoms of the early stage of surgical diseases in which, although diagnosis is more difficult, the immediate and ultimate results of treatment are best. I called these minimum symptoms of the earlier stages the "medical aspects," because patients seldom, if ever, seek the advice of the surgeon in this stage, but often that of their family physician, who has not been trained to recognize the significance of these symptoms as the beginning of a surgical lesion. If, then, we educate the

3. Bloodgood, J. C.: The Relation of Surgical Pathology to Surgical Diagnosis, Detroit Med. Jour., February, 1904, p. 337.
4. Bloodgood, J. C.: Medical Aspects of Surgical Diseases, or Preventive Surgery, THE JOURNAL A. M. A., March 23, 1912, p. 829.

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people to seek advice earlier and the family physician to properly interpret these lesser and apparently insignificant signs of future trouble, the surgeon will be called on more often to treat surgical lesions in their earlier stages, and will be forced to educate himself to meet the new requirements in diagnosis and treatment.

It is quite possible that the people may be educated ahead of the medical profession, but, whether they seek the surgeon's advice directly or are referred to the surgeon by the family physician in this earlier stage, the responsibility of the surgeon will be the same. If the surgeon is not prepared to make the diagnosis accurately and follow it with the appropriate treatment, these enlightened people may be worse off than if they had delayed.

The question is, therefore, Shall the people force the profession, or shall the profession educate itself and be prepared for these added responsibilities?

I am impressed with the belief that those surgeons who have educated themselves best have traveled and visited other surgical clinics most. Every experienced surgeon and every surgical clinic, as a rule, excels in some particular method of diagnosis and treatment. We must therefore learn from each other; reading, of course, is valuable, but visiting other clinics is more valuable.

The family physician and the clinician who does not operate must familiarize themselves with the best methods of diagnosis and treatment, so that they will be able to refer their patients to that surgeon who will give them the best methods and insure them the best immediate and permanent results.

I shall try in the remaining space to illustrate the added responsibility of the surgeon when called on to treat certain definite surgical lesions in definite localities in the earlier stages, and discuss briefly the methods of diagnosis and the treatment which should yield the best immediate and permanent results.

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PREPARATION FOR OPERATION

In the so-called acute surgical lesions there is little time for preparation and only time enough for those methods of clinical and laboratory investigation which will indicate what to do. The question to be settled is, Is there any indication for operation? Is the danger of immediate intervention less than of delay? As a matter of fact in this group the usual preparation for operation is not necessary, because the operative intervention relieves the patient of such a burden due to the acute condition that the resultant shock is often insignificant and readily borne. This is well illustrated by the difference in the behavior after operation of a patient with a non-strangulated reducible hernia, and of one with a strangulated hernia; between the convalescence from operation for acute appendicitis and for a chronic appendicitis operated on between attacks.

In acute surgical lesions delay affects chiefly the immediate mortality. The difference in the ultimate result is not so marked in the patients which recover.

The minimum symptoms of an acute surgical lesion which will allow a diagnosis in the stage which gives the best immediate and permanent results, are not such a difficult problem, and have been pretty well settled. The people are fairly well educated, and the family physician is more keen, and the surgeon better and better prepared to give the patient the best chances. This is true in acute appendicitis, in intestinal obstruction, perforation of gastric and duodenal ulcer, abdominal wounds and other acute conditions. There is room, nevertheless, for considerable improvement in the earlier recognition. The added responsibility of the surgeon when called on to treat these lesions in the earlier stage is not so evident. The chief danger is in delay, not in action. Laboratory methods of diagnosis, especially the leukocyte count, gastric lavage and the result of enemas, are often very helpful in the early hours.

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In the very earliest stages of acute abdominal lesions physician and surgeons fear chiefly that an operation may be performed when the symptoms are due to a non-operative condition, such as pneumonia or diaphragmatic pleurisy with abdominal symptoms, acute exanthems of children, or osteomyelitis with abdominal symptoms, etc. These cases are not, however, very frequent, and more deaths are due to delay on account of this fear than to operations based on mistaken diagnosis. Treatment in the late stages of acute abdominal lesions is the test for operative technic, especially anesthesia, which will be discussed later.

In surgical diseases, when there is no danger from delay, there is opportunity to exhaust every method of diagnosis and to employ every well-established preparatory treatment. The earlier the patient is seen and the less distinct the indication, the more elaborate and painstaking should be the investigation and the more careful the preparation. I believe the evidence will show that at the present stage of our development more mistakes are made by hurrying operative intervention in this chronic group, than by delay in the acute group.[5]

It has been my experience that this has been more especially so in patients suffering with symptoms suggesting chronic appendicitis. The patient, the family physician and the surgeon arrive quickly at such a diagnosis; people are so well educated in regard to the dangers of appendicitis that they welcome an excuse to have the appendix out. The preoperative treatment and diagnosis are usually insufficient. The appendix is removed through a small incision. The number of patients not relieved is increasing. The lesions usually overlooked are: some type of gastric and colic ptosis; some lesions of the pelvic organs or vaginal outlet; gastric or duodenal ulcer; chronic infections of the gall-

5. Bloodgood, J. C.: Estimation of the Vital Resistance of the Patient, with Reference to the Possibility of Recovery, Ann. Surg., May, 1912; Review on Progress of Surgery, Progr. Med., December, 1912.

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bladder; chronic pancreatitis; cancer of the colon, and even renal calculus.

When patients suffering from chronic surgical disease in its earlier stages are really thoroughly studied, the number of mistakes of this kind will be greatly lessened, and by careful preliminary treatment and operation under improved anesthetic technic the number of re-operations will be reduced, the immediate and permanent results improved almost to 100 per cent., and the period of discomfort and disability so shortened that surgery will not be feared as it now is.

OPERATION

When surgery is a last resort the surgeon can always find an excuse for his mortality or failure to cure permanently. The operative technical problem in these late cases is often so pressing that he is unable to give attention to certain details which, experience shows, add to the probability of recovery.

When the operation can be performed in the earlier stages, however, when the patient is in better condition, there is less, if any, excuse in many instances for a fatality and a failure to cure; but fortunately these patients when operated on early, usually survive the shock of the operation, and the failure to cure ultimately becomes a remote possibility. For this reason surgeons have been slow in investigating the cause of their mortality and their ultimate results. The chief mortality is in the group of operations instituted as a late and last resort, and the deaths are attributed to the disease rather than to the technic, and, as many surgeons do not systematically and critically ascertain their ultimate results, the more remote evidence of their failures does not come prominently into view.

Recently surgeons have paid more attention to the question of mortality due to operative technic and anesthesia, and have come to the conclusion that there is room for great improvement. The literature on shock

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due to operative trauma and bad anesthesia is now very extensive, and most surgeons are convinced that when surgery is an early resort even this small mortality may be decreased or eliminated by introducing certain changes in the anesthesia and in the technic of the operative procedure. While the results in mortality in this group are not so marked, they are very evident in a decrease of postoperative complications, lessened discomforts and shortened periods of disabilitv This improved technic of anesthesia and dissection in the graver groups of surgical operations will manifest itself in lessened mortality.

It is my opinion that the substitution of nitrous oxid and oxygen for even the best developed ether-drop anesthesia is a very important factor and that the combination of local anesthesia with this form of general anesthesia, or local anesthesia alone, when possible, will greatly eliminate surgical shock.

I am confident that the added responsibility of the surgeon when called on to treat surgical lesions in the earlier stage will force on him not only improved methods of diagnosis and preoperative treatment, but also improved methods of anesthesia and operative technic. Surgery must not only be an early intervention, but also as safe and free from discomfort as possible, and the period of disability must be shortened. This in itself will eliminate fear, instil confidence, and reduce the now well-recognized psychic shock.

SHOCK

The clinical picture of shock due to accidental injury is distinct only when the shock is extreme. It is very important in this group of cases for the surgeon to know as far as possible the effect of the injury on the general condition of the patient. The blood-pressure estimation gives a better picture of this than any clinical sign. In accident surgery this is generally neglected. It should be a routine examination.

When there has been much loss of blood from the accidental wound, blood transfusion should always be employed. Surgeons have been slow to learn the technic of this operation.

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No operation should be performed on a recently injured person with low blood-pressure, unless it is quite certain that the painful impressions from the wound are keeping up or increasing the shock, or there is still evidence of hemorrhage. In this event the wound should be so treated that it becomes painless, and the hemorrhage should be checked. I am confident that many injured patients are operated on too quickly after the accident when these indications are not present.

WOUNDS

In the treatment of a recent wound the chief function of surgery is to check hemorrhage, prevent infection, and to decide whether an operation should be performed on the wound then, or later, to restore function.

In the treatment of injured persons surgeons usually forget the possible accompanying shock and devote their attention to the wound.

In the treatment of accidental wounds there is the danger that the same technic employed for an operative wound will be neglected. If infection takes place in an accidental wound the surgeon can always attribute the complication to an infection at the time of the accident and before his treatment. The recent literature on accidental wounds seems to show that the infections are more apt to be secondary than primary.

In the treatment of an accidental wound, in the majority of cases, non-interference should be the rule. If interference is indicated, one must be quite certain that the patient's condition permits it, and the interference must be carried out after the same careful preparation as for an operative wound.

INFECTION

Most infections begin as a distinct local area characterized by pain, redness and swelling. The patients are always aware of this area from the onset. There is no difficulty for the surgeon in finding the local infection.

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In the early stage, when the condition is strictly local, the symptoms are not urgent. Both patient and physician are apt to delay. This, however, is the time for treatment. It can do no harm to the local infection which would heal without it, but it will be life-saving in some infections which are hopeless when generalized. This is due to the fact that our methods for the treatment of the local infection are adequate, while those for the treatment of general infection are usually insufficient. Delay is the most dangerous thing in infections.

The bacteriology of a local infection is, as a rule, not of great importance as an indication for treatment, but in some cases it is essential. The demonstration of the anthrax bacillus in the pus from a malignant carbuncle should indicate non-interference. Experience seems to show that such local infections do better when left alone. If any operation is to be done, the area should be excised with the cautery, while, on the other hand, when gas bacilli are found, even before the presence of gas bubbles in the pus, or emphysema, wide incisions should be made immediately, or, in some cases, immediate amputation of the extremity.

TUMORS

In no other group of surgical lesions is the responsibility of the surgeon greater than when he is called on to diagnose and treat tumors in their earlier stages.

It has been my good fortune to have had a large opportunity during the last twenty years to investigate this subject, and I have made a number of previous communications[6] on this problem.

6. Bloodgood, J. C.: The Importance of the Early Recognition and Operative Treatment of Malignant Tumors; The Variation of the Extent of the Operative Removal According to the Relative Malignancy of the Tumor: THE JOURNAL A. M. A., 1906, xlvii, 1470; The Clinical and Pathological Differential Diagnosis of Diseases of the Female Breast, Am. Jour. Med. Sc., 1908, cxxiv, 157; Conservative Operations on Bone Tumors, THE JOURNAL A. M. A., 1908, l, 325; The Medical and Surgical Aspects of Tumors, Wisconsin Med. Jour., 1910, ix; Recent Progress in the Surgical Treatment of Malignant Growths, THE JOURNAL A. M. A., 1910, lv, 1537; Surgical Treatment of Cutaneous Malignant Growths, THE JOURNAL A. M. A., 1910, lv, 1615.

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The more recent study of the ultimate results confirms the conclusions of these earlier papers.

The fact that makes the greatest impression when we investigate tumors of the skin and accessible mucous membranes, such as of the lip and tongue and subcutaneous tumors, is that in the onset, or beginning, there is always a visible or palpable lesion. Every patient remembers the onset. In some instances the tumor is congenital. In the beginning it is always small and, as a rule, painless.

In my experience, when the lesion is completely removed in this stage, there should be 100 per cent. of cures. Few persons seek advice and few physicians advise radical excisions in this stage. In the majority of cases nothing is done. The period of quiescence varies between weeks and years. During this period some patients have been subjected to treatment, for instance, with the Roentgen-rays, radium, caustics or carbon-dioxid snow. Even after the lesion begins to grow and perhaps ulcerate, both patients and physicians still delay, and again palliative treatment is employed in some cases.

From an investigation of a large amount of material I am convinced that, with one exception, the treatment which promises the greatest number of cures with the least mutilation is complete excision with the knife. In angioma, which cannot be excised without some mutilation, the treatment with carbon-dioxid snow is justifiable.

In early small lesions there is no necessity for a microscopic diagnosis before operation; the nodule can and should be completely excised. Even an encapsulated nodule should never be enucleated.

All lesions of this kind may be called precancerous. Among my personally studied cases I do not know of a single recurrence after the proper excision.

It is quite true that the precancerous lesion may be eradicated with the cautery, but then we have no microscopic control.

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After the lesion has become larger, the problem of diagnosis and treatment becomes more difficult, because different pathologic processes in different localities require for their permanent cure local excision of varying extent. When we can completely excise the disease, with a zone of uninvolved tissue without mutilation, this should always be the operation of choice; but for malignant disease of the type of cancer this is not always sufficient, because in such cases the neighboring lymph-vessels should always be removed.

It is impossible in this paper to consider the details of treatment in the later stages of lesions of different character in different localities. My material demonstrates that in the early or precancerous stage, complete excision of the local area should be the operation of choice, and, to repeat, enucleation should never be performed. Every lesion excised should be studied microscopically, and tissues and records should be preserved for the control of the ultimate results.

The people should be educated in regard to the potential dangers of malignant disease in these apparently innocent precancerous lesions. Surgeons should study their material and become familiar with the methods of diagnosis and operative treatment which offer the best chance of a permanent cure for the different lesions in the different localizations.

These deductions have been made from 406 cases of benign connective-tissue tumors, 48 cases of sarcoma of the skin, 84 cases of subcutaneous sarcoma, about 150 cases of benign and malignant pigmented moles, and 1,000 cases of epithelial tumors of the skin and exposed mucous membranes.

The failure to cure in cancer of the skin and mucous membranes is due to the delay in the complete eradication of the cancerous lesion; to non-operative, irritating treatment in the precancerous and cancerous stages; to incomplete local operations in both the benign and malignant stages, and to the failure to remove the neigh-

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boring lymph-nodes *en bloc* in certain types of cancer in certain localities.

I feel confident that with an educated laity and medical profession and a properly trained surgeon, we should no longer fear cancer of the lip, tongue, gum, mucous membrane of the mouth and of the skin of the body. The evidence seems to show that when cancer is treated in the earliest stages the percentage of cures should approach 100. In cancer of the penis this is equally true. In cancer of the tonsil, pharnyx, nose and antrum, however, the problem is much more difficult and the chances of a cure are at present relatively small, even in cases that have been recognized early.

The problem of the employment of the Paquelin cautery, with or without simultaneous excision with the knife, is one to which the surgeon should give considerable attention in the future. My recent experience teaches me that with the Paquelin we may be able to accomplish cures in the early cancerous lesion with less mutilation than has been possible heretofore with the knife. This is especially true of cancer in the region of the jaws, arising from the mucous membrane of the gum, mouth and tongue.

The chief hope, however, of increasing the number of cures in cancer of the accessible mucous membranes and skin must rest with education of the people on the precancerous lesion and the education of the surgeon on its proper removal. There is also hope of increasing the number of cures in the later stages of cancer in these regions by improvement in our operative technic and the employment of the cautery.

It is important to repeat here that a portion of a benign lesion left behind after improper treatment by excision or caustics is potentially more dangerous through the development of cancer than the untreated lesion, and that any incomplete operation in the early stage of cancer gives far worse results than complete operation in later stages. In fact, in some localizations it transforms a comparatively favorable case into a hopeless one.

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MUSCLE

There are no clinical differential signs between the early stages of the different forms of myositis and sarcoma. There is only one type of myositis that can be recognized positively without operation. This is the ossifying myositis, and the Roentgen-ray showing the bone formation in the muscle excludes sarcoma. These palpable nodules in the muscle should always be explored at once, unless roentgenoscopy shows bone formation, or the blood gives the Wassermann reaction and the muscle nodule disappears under salvarsan.

The diagnosis between the benign myositis and the sarcoma must be made at the exploratory incision. The indicated operation is simple. Complete removal of the sarcoma offers a great probability of a cure, but would be an unnecessarily mutilating operation if the lesion were myositis.

JOINTS

The probability of a malignant lesion of the soft parts of a joint is so slight that the possibility need hardly be considered in the early diagnosis and treatment of the different types of arthritis. Mistakes in failing to recognize sarcoma of the synovial membrane would affect but few persons. The chief defect at present in our results in the treatment of arthritis is that we usually accomplish a cure only with some impairment of joint function up to complete ankylosis. The evidence seems to indicate that when joint lesions are properly diagnosed in the earlier stages cures should be accomplished in the greater number with perfect restoration of function. Here the diagnostic measures investigate not only the joint lesions, but look for a portal of infection which, we now know, is the cause of the metastatic synovitis in the majority of cases. The problem is too large for thorough discussion here, but it illustrates the added responsibilitv of the surgeon, in that when he is called on to treat an arthritis in the early stage he should expect to accomplish a cure with restoration of joint function.

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Diseases of bone in their late stages are easily recognized, but treatment in these stages gives comparatively poor results. In the more malignant sarcomas of bone, cures are rarely accomplished even by the highest amputation. In the less malignant sarcomas, such as the giant-cell tumor, resection or amputation may have to be done, while, if treatment had been instituted in the early stage, a cure could probably have been accomplished by curetting without interference with the continuity of the bone. Even in the benign bone cyst, delay may be associated with so much destruction or thinning of the bone capsule that resection, or even amputation, may be necessary. In pyogenic osteomyelitis and tuberculosis of the bone the later stages offer no difficulties in diagnosis, but are the greatest test of the operative technic, and rarely do we accomplish cures without ankylosis of the neighboring joints or loss of continuity of the bone. The relation of trauma to bone diseases is not appreciated either by the patient or by the profession. If the trauma is severe and the loss of function marked, a roentgenogram is made and the clinically recognizable fracture portrayed. But in traumas of lesser degree, involving the soft parts, bones and joints without the clinical signs of fracture, roentgenoscopy is usually neglected because it is inconvenient and expensive. In such cases slight fractures without deformity and joint fractures are overlooked. But more serious are the diseases which may follow the injury. The immediate effects of the injury—swelling, pain—are diagnosed contusion or traumatic arthritis. When these do not subside or when they recur after a temporary cessation, the possibility of a malignant tumor or a grave inflammatory lesion is not thought of until the clinical picture is such that the diagnosis is not difficult; but the prognosis from treatment has changed to a grave one. We have sufficient evidence to show that sarcomas of the soft parts and bone are very

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frequent after injury, and inflammatory processes, such as tuberculosis, syphilis, gonorrhea and pyogenic inflammations are localized by the trauma.

Immediately after a trauma roentgenogram should be taken, and this should be repeated at intervals until all the signs of the traumatic inflammation have subsided. If after the original injury the reaction to the trauma has been but slight and then, after an interval, such symptoms as localized pain, swelling or slight impairment of function appear, a roentgenogram should immediately be taken. This diagnostic aid is perhaps most helpful in the early stage of lesions of bones and joints. In all of these cases a Wassermann test should be made, and if this proves positive, salvarsan should be administered as a therapeutic test. A tuberculin test should be made and the urine examined for Bence-Jones bodies.

In many cases, even if this evidence is against malignant disease, an exploratory incision for diagnostic purposes should be made in all cases of doubt. If these tests have been made and the clinical record carefully studied, the surgeon should be able to identify at once the pathologic process at the exploratory incision and institute appropriate treatment. Only in this way shall we accomplish cures in the more malignant bone tumors. At present cures are few. In all other bone lesions cures will be accomplished in a greater number of cases with very much less, if any, mutilation.[7]

Localized pain in the region of a bone or joint, slight limp, early fatigue, and insignificant swelling are usually treated for rheumatism or some other simple condition and not subjected to thorough diagnostic study. These symptoms may be the first warnings of a serious disease, and in this period investigation is more important than symptomatic treatment.

7. Bloodgood, J. C.: Benign Bone Cysts, Ostitis Fibrosa, Giant-Cell Sarcoma, Bone Aneurysm, Ann. Surg., August, 1910, p. 145; The Conservative Treatment of Giant-Cell Sarcoma, Ann. Surg., August, 1912.

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In going over the cases of bone tumors and inflammations of bones and joints I have been impressed with these definite early signs recorded in the histories, which in the great majority of cases have excited less interest in the examining physician than in the patient. I have searched my own records and the literature in vain for roentgenograms taken in the early stage of sarcoma.

BLOOD-VESSELS

The recent development of the surgical technic of blood-vessel suture and transplantation has made it imperative for surgeons to recognize blood-vessel injuries early. In trauma to the extremities the examining surgeon rarely palpates for pulsation in the peripheral arteries or tests for anesthesia. He looks only for the grosser injuries at the seat of trauma, and if he finds a fracture, he takes a roentgenogram, reduces the fracture, puts it up in plaster, and overlooks the possible thrombosed artery secondary to the contusion. He is much surprised at the end of a few days to find signs of gangrene. To overlook the ruptured nerve is a mistake less serious in its consequences. Embolism to the peripheral arteries after operation is not an infrequent complication and may result in gangrene. The signs of this complication are immediate, but, as a rule, not intense. The pain causes the nurse to rub the extremity; the numbness is attributed to some pressure on a nerve during the operation; the coldness brings the hot-water bag; but rarely is a careful examination made for the pulsation of the peripheral arteries. Such an examination in the early hours would lead at once to the diagnosis and exposure of the artery plugged with an embolus. Such cases have already been recorded in the literature. As a rule, it is only the appearance of discoloration that creates alarm and leads to an investigation, but now a correct diagnosis will not save the limb.

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GANGRENE

The recognition of this lesion of the extremity and its treatment by amputation is not difficult, but the result cannot be considered a triumph for surgery. The pregangrenous symptoms—intermittent pain, tingling and coldness do not, as a rule, lead to a careful investigation of the peripheral circulation and appropriate treatment to prevent further interference with circulation. Patients with symptoms of this kind will show arteriosclerosis with, or without, diabetes. Such patients should be cautioned as to the danger of overexertion, and the dangers of slight infections from the treatment of corns, hangnails and ingrowing nails. Most of these patients, if the arterial disease is recognized promptly, can be protected with a greater degree of success from the complication of gangrene.

THYROID

The problem here is unusually simple. There are practically but three great indications for operation on the thyroid gland: toxic symptoms, the size of tumor with symptoms of pressure, and nodules in the thyroid gland. The minimum toxic symptoms of exophthalmic goiter are now well understood. The leukocyte count is usually the most neglected sign. There is some difference of opinion as to how long one should wait with operation in exophthalmic goiter. The majority of surgeons who have the responsibility of the operation are glad of an opportunity to operate early. In these early interventions no harm is done. The longer one waits as the toxic symptoms increase, the higher the mortality and the less the probability of a cure. It appeals to surgeons, and I believe that in the future it will appeal to patients, that it is better to run the risk of an operation that might be unnecessary than to wait for an urgent operation with a high mortality. The postoperative mortality in Mayo's clinic[8] is 3 per cent. One can feel pretty confident that this mortality is due to a

8. Mayo, Charles H.: Surgery of the Thyroid, THE JOURNAL A. M. A., July 5, 1913, p. 10.

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late intervention over which the surgeon had no control. When the size or pressure symptoms indicate partial thyroidectomy there should be no mortality, if there is no delay and surgical technic is good. Kocher has demonstrated this. The object of removing a nodule in the thyroid gland is to eradicate a possible cancerous nodule in its earliest and most curable stage. In 1905 I called attention[9] to the fact that in the material of the surgical clinic of the Johns Hopkins Hospital and in the literature I knew of not a single recorded case of cured cancer of the thyroid gland diagnosed clinically. The only cures which had been accomplished were among those clinically benign, excised radically on the diagnosis of a benign cyst or adenoma, and then found to be cancer under the microscope. This statement holds true to-day, from a much larger experience. When, therefore, the surgeon attacks a nodular tumor of the thyroid, he should bear in mind the possibility of malignancy. The nodule should not be enucleated, but removed with a zone of uninvolved thyroid tissue, even up to complete lobectomy. When the nodule is single, the operation is not difficult, but when nodules are multiple, or present in both lobes, the technical difficulties of complete excision of the nodules with preservation of some thyroid tissue and of the parathyroids may well tax the skill of the most experienced surgeon. These nodules, whether single or multiple, are always small in the beginning, and there is no excuse for the delay which adds to the difficulty of the operative technic.

In lesions of the thyroid gland the indications for treatment are always based on clinical evidence. The pathology is only an interesting *post hoc*.

SALIVARY GLANDS

Space permits the discussion of but one tumor in this region—the so-called mixed tumor. This encapsulated neoplasm may be present in, or in the region of, any of

9. Bloodgood, J. C.: Cysts of the Thyroid Gland, a Clinical and Pathologic Study, Surg., Gynec. and Obst., August, 1905, p. 115.

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the salivary glands. It is a distinctly benign tumor in its beginning. After its complete removal there should be 100 per cent. of cures. In my experience recurrences are due entirely to removal by enucleation. The capsule of this tumor is thin, and during enucleation small pieces of the capsule are torn and left in the wound. I believe that enucleation has been chosen by some surgeons because of fear of injury to the facial nerve, the majority of these tumors being situated near it. From my experience I am confident that, if the tumor is attacked when it is small, it can be completely removed without injury to the facial nerve.

In a very few cases the nerve may pass through the tumor. In such instances the tumor should be dissected widely as in any other case, and the nerve isolated, but not divided; when the tumor has been completely isolated from all tissues except the nerve, it should be surrounded with gauze saturated in alcohol and split, and the nerve should be freed, wiped with alcohol, and dropped back into the wound after removal of the tumor.

BREAST LESIONS

The experience of the Surgical Pathologic Laboratory of the Johns Hopkins Hospital is most extensive and complete with lesions of the breast. We have at present a record of 1,311 cases of which 769 are malignant and 542 benign. I have considered the problems of diagnosis and treatment in the Muetter Lecture delivered in December, 1912, in Philadelphia. As this is about to be published, I shall not take much space for a detailed discussion.

In the vast majority of cases the symptoms of onset of a breast lesion is a lump. In women over 25 there is always a possibility that this lump may be cancer. If one delays until the clinical signs of cancer are evident and then performs the complete operation following the technic of Halsted, the probability of a cure in our experience is 30 per cent. or less. When the tumor is explored before the clinical signs of cancer, and the

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diagnosis of cancer made at this exploratory incision is immediately followed by the complete operation, if the diagnosis is cancer, the probability of a cure, in our experience, is 80 per cent. or more. I have no available facts as yet to indicate what the probability of a cure would be if every woman over 25 having a tumor of the breast were to submit it to an operation within a few days after the appearance of the tumor. It would be at least 80 per cent., probably more.

The object, therefore, of exploring a lump in the breast immediately after its appearance is to remove cancer radically in its most curable stage.

To this laboratory many cases of breast tumors are sent for diagnosis from all parts of the country. I have now records of about fifty cases in which only the lump was removed; the diagnosis of cancer was then made in the laboratory, and the complete operation advised. The interval, of course, between the removal of the lump and the complete operation has always been a few days or more. In this group I have been unable to find a single five-year cure. This shows the danger of exploring a lump in the breast in this most favorable period unless the suregon is prepared then and there to make the diagnosis and to follow it, if necessary, at once by the complete operation for cancer. In the paper about to be published I think that I shall be able to show that in the majority of cases the diagnosis can be made by the gross appearances at the exploratory incision. In cases of doubt, the lesions should be treated as cancer. In some lesions the frozen section will be helpful; in others it will not aid, but only add to the confusion.

These facts exemplify the tremendous responsibility of the surgeon who is called on to explore a breast lesion in the early stage, when the diagnosis must be made at the exploration. It will add much to the weight of this statement when other large clinics study their cases along the same lines and confirm these conclusions.

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The other symptoms at the onset of breast lesions are pain, discharge from the nipple, retraction and ulceration of the nipple, dimpling of the skin and enlarged lymph-nodes in the axilla. Unfortunately pain is not a symptom of onset in cancer, except rarely. I say unfortunately, because my tables show that patients with benign tumors seek advice earlier than patients with cancer. Both have lumps, but the benign tumors are more frequently associated with pain. It must, therefore, be the pain that brings the patient with the innocent lump for treatment in an earlier stage. Discharge from the nipple is not a sign of malignancy and, so far as I know, is not of itself an indication for operation. Retraction and ulceration of the nipple are so rarely associated with benign lesions that they should be looked on as positive signs of cancer and indicate immediate radical operation without exploratory operation, except in a very few isolated cases in which there are other definite signs allowing a diagnosis of mastitis. Dimpling of the skin should be looked on as a sign of cancer.

In my experience,[10] enlarged lymph-nodes in the axilla have pointed to the diagnosis of cancer of the breast once in 769 cases. Here the lymph-nodes were so large and hard that one could be quite certain that they were due to metastatic cancer. Nothing could be felt in the large fatty breast, but after the complete operation for cancer, a small scirrhous carcinoma was found buried in the breast tissue. We may therefore state that palpable lymph-nodes in the axilla are not particularly helpful in the diagnosis. Their absence does not exclude cancer, their presence does not necessarily mean cancer.

10. Bloodgood, J. C.: Senile Parenchymatous Hypertrophy of the Female Breast and Its Relation to Cyst Formation and Carcinoma, Surg., Gynec. and Obst., December, 1906, p. 721; The Clinical and Pathologic Differential Diagnosis of Diseases of the Female Breast, Am. Jour. Med. Sc., February, 1908, p. 157; Cancer Cysts of the Breast and Their Relation to Non-Malignant Cysts, THE JOURNAL A. M. A., Oct. 30, 1909, 1475. Kelly and Noble: Inflammations and Tumors of the Female Breast, Gynecologic and Abdominal Surgery, 1908, ii, 180.

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SURGICAL DISEASES OF THE JAW[11]

In a clinical and pathologic study of 150 cases of diseases of, and in the region of, the lower jaw I find[12] that in 112 cases the lesion was either benign or of such a low grade of malignancy that the probability of a cure from complete excision reached almost 100 per cent. The chief fault to find with the results in these cases was the mutilation necessary in order to remove the disease completely. In all of these cases this necessity was due to delay in treatment. The following list illustrates the types of the curable diseases of the jaw:

Ossifying periostitis	4 cases
Epulis	50 cases
Periosteal osteosarcoma	3 cases
Periosteal fibrosarcoma	11 cases
Giant-cell tumor of medullary cavity of the lower jaw	4 cases
Dentigerous cysts	19 cases
Adamantine epithelioma	21 cases

In all of these cases the symptom of onset is usually a distinct swelling along the alveolar border of the jaws, of the body of the lower jaw or of the antrum. Dentists are not sufficiently educated on these diseases, nor do physicians recognize the significance of the early signs. As pain is not a prominent symptom, the patients as a rule wait until the swelling interferes with mastication or results in deformity. In this group we have experienced but few failures to cure, but delay always increases the necessary mutilation. As a rule the diagnosis can be made from the clinical evidence and from roentgenoscopy or at the exploratory incision. It should not be necessary to excise a piece for diagnosis.

In our experience we have failed to accomplish a single cure in thirty-eight cases, twelve of spindle-and-round-cell sarcoma arising from the periosteum about

11. Bryant and Buck: American Practice of Surgery, 1909, vi, 813.

12. Bloodgood, J. C.: Recent Progress in Surgical Treatment of Malignant Growths, THE JOURNAL A. M. A., Oct. 29, 1910, p. 1537.

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the body of the lower jaw or in the region of the antrum, and in twenty-six cases of carcinoma of the antrum, the latter arising either in the antrum, or secondary to nasal polypi. Most of these patients came under observation late. What the result would have been if treatment had been instituted in the onset is difficult to say. From this evidence a safe rule to follow in doubtful cases will be to treat the lesion as one of the curable type and not produce unnecessary mutilation on a diagnosis of the more malignant lesion. To accomplish cures in cancer of the antrum we must recognize and properly eradicate nasal polypi and ulcers in their benign or precancerous stage.

ABDOMEN

In the first few hours after a contusion of the abdomen it is very difficult to distinguish intra-abdominal hemorrhage from shock due to the contusion alone. When the hemorrhage is intraperitoneal one should find movable dullness in the flank; when extraperitoneal, there should be blood in the urine in the majority of cases, and very quickly a palpable swelling in the iliac fossa. If in cases of hemorrhage operation is not done quickly, there is little hope for recovery. It has been my experience that it is much better in case of doubt to open the abdomen at once under local anesthesia. This can be done practically without increasing shock. The literature is filled with reports of brilliant results after operations based on prompt decision.

In contusion with rupture of the stomach or intestines, the symptoms of rupture are not distinct. It has been my experience that the decision as to laparotomy should be made within six hours. If the pain and muscle spasm do not disappear and the leukocytes rise, the abdomen should be opened at once. Quite frequently the findings will be negative, but no harm should follow the exploration, while delay for the more positive signs of peritonitis is usually fatal.

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The early recognition of intestinal obstruction not only makes the probability of recovery relatively very great, even approaching 100 per cent., but also simplifies the operative procedure and shortens the time of convalescence.

For the first symptoms of intestinal obstruction the patient is apt to receive home treatment in the form of cathartics and blistering applications. The physician, when called on, usually treats the case symptomatically and gives more cathartics and morphin. In the presence of abdominal pain with or without nausea and vomiting and a history of constipation, the safe attitude is one of keen observation and painstaking investigation. Ochsner has truly said that if a cathartic is really indicated no harm is done by delay, while if it is contra-indicated its administration adds only to the danger of the situation. From an investigation of over 300 cases of intestinal obstruction of which I have records in the Sugical Pathological Laboratory[13] I find that the average mortality is 40 per cent. Much of this is due to late intervention, some to bad anesthesia and faulty surgery.

The diagnosis of intestinal obstruction in a period most favorable for operation should not be difficult. It depends on a careful history, an examination of the abdomen by palpation and percussion, a leukocyte count and the results of an enema and gastric lavage. During this examination nothing should be given by mouth and no morphin, unless the pain is intense. As a matter of fact, pain of this character, unless one is certain that it is due to renal colic or gall-stones, indicates morphin for relief followed by immediate exploration of the abdomen.

When the abdomen is opened in the very early hours of obstruction, it is safe to find and relieve the obstruc-

13. Bloodgood, J. C.: Intestinal Obstruction due to Volvulus or Adhesions of the Sigmoid Colon, Ann. Surg., February, 1909; Intestinal Obstruction, Maryland Med. Jour., April, 1907, p. 245. McGlannan, A.: Intestinal Obstruction, a Clinical Study of One Hundred and Eighty-One Cases, THE JOURNAL A. M. A., March 8, 1913, p. 733.

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tion first. But in the later hours the first thing to do is to evacuate the intestine above the point of obstruction and prepare for enterostomy or colostomy. This, from McGlannan's study, shows a great increase in the number of recoveries. The relief of the obstruction at this operation will depend, first, on the condition of the patient and, second, on the character of the obstruction. In the presence of gangrene in the intestine, resection must be done rapidly; restoration by anastomosis must depend on the condition of the patient and the high position of the gangrene in the small intestine. In cases of doubt the intestine should always be evacuated and enterostomy or colostomy performed.

The later the stage of intestinal obstruction, the easier the diagnosis; the more difficult the problem of anesthesia and operative technic, the worse the prognosis.

STOMACH AND DUODENUM

There is yet no consensus of opinion as to what should constitute the minimum symptoms which would justify an exploration of the stomach and duodenum. All agree as to the maximum symptoms. From my investigation of a relatively small group of cases I have the impression that, unless we believe that the chief danger of delay is due to the possibility of cancer, we shall not progress in the cure of cancer of the stomach. At present the great mass of people favor the exploration of the appendix, but not of the stomach. If the family physician or specialists do not advise operation when the symptoms suggest appendicitis, they as a rule lose the patient who goes to the surgeon independently; but when they advise exploration of the stomach for a minimum of symptoms, they also lose the patient, but in this event the patient seeks the advice of some one who will treat him medically. Cancer of the stomach in its onset, in a stage in which complete resection promises the best opportunity of a cure, has no distinctive symptoms. If, fortunately, from its position near the pylo-

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rus, it produces definite obstruction early, the patient has the best chance of a cure, because the entire profession to-day agrees that signs of pyloric obstruction are an indication for immediate operation. Kocher, from his large experience with cancer of the stomach, found that almost all of his patients who have remained well after resection suffered from a movable cancerous nodule in the pylorus producing obstruction early in its growth. Unfortunately many cancers of the stomach, even when situated near the pylorus, produce but partial obstruction, and patients with this condition can be kept quite comfortable for a time under restricted and selected diet with or without gastric lavage. I believe that patients with cancer of the stomach can be treated medically too well. They may be made so relatively comfortable that they do not wish for operative relief until it is too late.

When the surgeon opens the abdomen of a patient with symptoms suggesting a gastric or duodenal lesion at any period in the clinical course, he is confronted with many dilemmas. In early cases the ulcer may be difficult to find; the symptoms may be due to lesions not in the stomach or duodenum; they may be due to chronic cholecystitis without stone, to a chronic pancreatitis, to ptosis of stomach and colon or to chronic dilatation of the duodenum.[14] Cancer of the transverse colon in its early stage may be associated with only gastric symptoms; chronic appendicitis may have caused no symptoms whatever referred to the region of the appendix, but all to the stomach or duodenum. In the last few months I had two such cases; both presented the clinical picture of duodenal ulcer, but roentgenoscopy and the study of the gastric contents seemed to exclude a lesion of the stomach or duodenum. I first explored the appendix under novocain and found sufficient trouble here to indicate without doubt a chronic appendi-

14. Bloodgood, J. C.: Dilatation of the Duodenum in Relation to Surgery of the Stomach and Colon, THE JOURNAL A. M. A., July 13, 1912, p. 117.

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citis. While I was removing the appendix and pulling on its mesentery, the patient stated that I reproduced his gastric attacks precisely. These attacks consisted of epigastric pain and nausea from two to four hours after eating; the larger the meal, the worse the attack. This may prove a good method of operative diagnosis.

The earlier the intervention, therefore, on patients with suggestive gastric and duodenal symptoms, the greater the responsibility of the surgeon. He will experience greater difficulty in finding the lesion to explain the symptoms; in the lesser gastric and duodenal diseases he will have to make his choice between a Finney pyloroplasty and gastro-enterostomy, and resection of the right colon for the dilated duodenum.

It seems to be the consensus of expert opinion to-day that indurated nodules in the stomach should be resected.

We now have sufficient evidence to show that exploration of the stomach in the early stage, when the minimum symptoms only are present, will greatly increase the number of cures of cancer and, in addition, improve the results in the non-malignant lesions; but operations in this period require far greater experience in the diagnosis of the findings at this operation. The responsibilities are greater and the surgeon must be more of an expert.

GALLSTONES

Much has been written on the importance of early operation for cholecystitis with or without gallstones, but really little has been said on what should constitute the minimum symptoms to justify an exploration of the gall-bladder and ducts. In the past five years, with the aid of the fourth-year medical students, we have restudied, in relation to the ultimate results, all of the cases of acute and chronic cholecystitis with and without gallstones, and of stone in the common duct. Space prevents more than a brief summary. Here we have a large group of cases in which we know exactly the

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pathologic findings at operation; we also know the present result, and we now have pretty accurate clinical records due to the retaking of many histories. With the rarest exceptions, all of these patients have had a definite etiologic factor for the infection of the gall-bladder and ducts. The period of their continuous or remittent discomforts has been relatively long.

These clinical symptoms may be divided into three groups which I have called typical, atypical and obscure. By typical symptoms I mean an attack of gall-bladder colic, or obstructive jaundice. If the patients wait long enough they will as a rule, suffer from one or more of such typical attacks. During this time they may have atypical attacks, that is, pain coming on acutely, but not situated in the gall-bladder area or referred above the diaphragm. In some histories the frequent occurrence of typical and atypical attacks should convince us that as a matter of fact the so-called atypical attacks should be as suggestive as the typical ones.

In addition to these two types of definite attacks, the patients may suffer from obscure symptoms. These symptoms may be remittent or continuous. The chief obscure symptom complained of in this group is unexplained indigestion. As a rule the patients are robust, well-nourished persons who suddenly, without change of diet, occupation or environment, or without excess in alcohol or tobacco, begin to have attacks of indigestion, discomforts after eating, belching, constipation, even unexplained nausea and vomiting. In some cases this is the entire clinical picture—the patients remember no typical or atypical attacks. Nevertheless, in patients from whom we can elicit nothing more than an attack of typhoid or some other infectious disease, and who complain only of these obscure symptoms of indigestion, we find at operation cholecystitis, pericholecystitis and gall-stones, lesions just as pronounced as in patients who had many typical or atypical attacks.

In this group of cases a painstaking history and a most careful routine examination is most helpful,

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because when the abdomen is explored, no definite lesion may be found: there are no gall-stones, no adhesions; a slightly enlarged, tense gall-bladder is the rule in all patients starved before operation. Again and again I have drained the gall-bladder because of the clinical symptoms alone associated with a negative examination before and during operation. On opening the gall-bladder, however, I have always found certain gross changes in its mucous membrane, and microscopic studies of a piece excised from such a gall-bladder have always revealed signs of chronic inflammation, usually with dilatation of Luschka's glands.

The next operative dilemma is to exclude by palpation a movable stone in the common duct. Fortunately this does not often occur, but now and then there may be a stone in the common duct without a history of obstructive jaundice and no dilatation of the duct at operation. Halsted demonstrated to me in 1893 when I was assisting him at operations of this character, that when one opens the peritoneum above the duodenum to the right of the common duct, the fingers of the left hand can be placed behind the common duct and moved from its terminal end in the duodenum up to the hilus of the liver, with the right hand above, the entire duct can be palpated between the fingers of the two hands throughout its entire extremity. There are many other dilemmas which present themselves to the surgeon at operations: When shall the gall-bladder be removed? How can we differentiate cancer of the gall-bladder from hypertrophy of Luschka's glands? How can we differentiate an operable cancer of the diverticulum of Vater, or of the head of the pancreas from chronic pancreatitis? What shall we do for chronic pancreatitis producing obstruction of the common duct—dilate the duct into the duodenum and drain the gall-bladder, or perform cholecystenterostomy? When there are many small stones, how can we be sure that we have removed them all? This investigation has led me to believe that the earlier interventions will undoubtedly give the best

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results, but they will not necessarily decrease the difficulties of the surgeon in deciding what will give a patient the best chance of an ultimate cure. The immediate mortality in the early cases is practically nil.

One clinical observation has made a great impression on me in recent years, and that is that patients who suffer from recurrent attacks of so-called acute indi gestion, who are relieved by restricted and guarded diet have, not gall-stones, but chronic pancreatitis. Even when the gall-bladders of patients are temporarily drained, they will not be relieved of their attacks, if they again commit indiscretions in diet. These patients remain well without operation when they are careful of their diet. I do not believe that this often happens when there are gall-stones or chronic cholecystitis with pericholecystitis. Perhaps it is these cases that furnish most of the cures in the many German watering-places.

APPENDICITIS

Gangrene, perforation, appendicular abscess and appendicular peritonitis are simply expressions of late intervention. Fortunately the number of these cases is rapidly decreasing, and even our mortality when these complications are present is growing distinctly less, owing to earlier intervention in this late stage. The number of cases of appendicitis subjected to operation in the first few hours after the first symptoms, and especially between attacks, is increasing, so that as a matter of fact, to-day new problems are presenting themselves, more difficult to solve; but fortunately our failures are not associated with increased mortality, but simply failure to cure permanently by one operation. When the abdomen is opened very early in acute appendicitis, or between attacks, we may find great difficulty in deciding whether the appendix is the cause, or the only cause, of the symptoms and signs present before operation. The day for operating on chronic appendicitis between attacks without a most exhaustive clinical history and examination has passed. Surgeons are beginning to

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appreciate more and more the other conditions which may suggest appendicitis, and at operation through larger incisions they are increasing their field of inspection.

From this evidence we can safely say to-day that the surgeon's responsibilties are greater when he is called on to treat surgical diseases in their earlier stages; but we may be confident that as our experience grows with the diagnosis and treatment in this most favorable period, we shall have less and less trouble. Operations in this stage will show an improvement not only in immediate results, but also, and more especially, in the permanent cures. The postoperative complications and discomforts will be greatly reduced, and the period of disability shortened.

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ABSTRACT OF DISCUSSION

DR. A. B. KANAVEL, Chicago: One point made by Dr. Bloodgood is well worth consideration, and that is this: When the clinical observations are not borne out by physical examination, we should not of necessity accept the results of the latter. In the present stage of pathologic diagnosis of disease, we are in danger of being too much inclined to depend on a microscopic examination when it is at variance with clinical observation. Clinical observation formed the basis of diagnosis by the older practitioners. In gall-bladder disease there is no need of waiting until the patient has jaundice, when the diagnosis can be made long before the appearance of the jaundice. Why, in appendicitis, wait until the patient has either a general or a local peritonitis? And in ulcer of the stomach or duodenum, why wait for a perforation? We must learn to appreciate the value of an early diagnosis in these cases and that can be done only by having a proper respect for and being able to recognize early symptoms, so that the patient may be sent to the surgeon promptly. The surgeon should teach himself to differentiate medical from surgical lesions, without any relation to which surgical lesion is present, so that he may be prepared to operate on a patient early and not wait for the later symptoms which make the case more severe. In chronic cases particularly, patients are kept waiting for months and even years before they are operated on, and then it is often too late. The greatest difficulty comes in the acute cases of which Dr. Bloodgood spoke. Patients come to us with a typical surgical syndrome; they complain

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of nausea and vomiting and sudden severe abdominal pain, followed in a few hours by tenderness and rigidity of a portion of the abdomen. It does not matter which particular organ gives rise to that syndrome of symptoms. It means that there is present a severe surgical lesion which demands intervention. It may be an appendicitis, a gangrenous gallbladder, a peritonitis, a duodenal ulcer, a strangulated ovarian cyst, a diverticulitis, or something else, but, no matter what it is, immediate surgical intervention is indicated. To my mind, if the surgeon and physician would recognize this group of symptoms as essentially a surgical syndrome and would impress that fact not only on the patient but also on the general practitioner, the operation would be performed much sooner than it is now, and more patients would be saved. Unfortunately, the necessity for early surgical intervention is not recognized at a time when the greatest good could be accomplished and the result is that the surgeon is called on to treat a complication rather than an early stage of the condition, and the patient's recovery is made more difficult. I urge that this syndrome be recognized as an acute surgical abdominal crisis, a clinical entity demanding surgical intervention.

DR. A. J. OCHSNER, Chicago: We all recognize the splendid work Dr. Bloodgood has been doing in the past in establishing what we might call clinical and pathologic facts. His work has given us a tendency to standardize our views regarding clinical studies of cases, as well as end results. When we have come to the point at which there is great uniformity in our methods of determining a diagnosis, so that we have definite ideas which are almost universal in our profession, then the time will come when we shall make the fewest mistakes. The matter of etiology, pathology and treatment is quite different. Precedent has shown so far that every time in medicine and surgery when we have felt absolutely sure about anything, we have been mistaken. That is exactly what will happen when we have completed our standardization to a degree of uniformity. It is always well to maintain a beneficent distrust of anything that is settled. In Dr. Bloodgood's work, all of these old, well-established facts that everybody took for granted have fallen down. In the future what Dr. Bloodgood is doing and is teaching us to do will come to the same end. As an instance we may take the plan of determining pathologic conditions during the progress of an operation by means of frozen section. In removing a growth, if the pathologist makes his section through the malignant portion, he diagnoses cancer, but if he has made a section through a portion of tissue that does not show cancer, he will make the opposite diagnosis. He may make many sections but miss the portion which contains the nodule of malig-

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nancy. If we accept his diagnosis, we do not do the radical operation and the patient suffers as a result of this systematic, well-established and universally accepted method; we must not forget, therefore, the great importance of not trusting any system. I wish to point out one most important thing that Dr. Bloodgood has told us. He has found that wherever there is a superficial cancer it has developed on a previous lesion. That means that cancer is infectious and that in every one of these cases the infection took place at the seat of a previous lesion.

DR. FRANK D. GRAY, Jersey City, N. J.: This question deals with responsibility and I should like to call the attention of the surgeons to two kinds of responsibility which they must shoulder. First, there is the responsibility of never operating with a fixed conception of a diagnosis, because you may frequently find that the diagnosis is wrong and that you must do something other than you had planned. You know how frequently that applies to appendicitis. We operate and find a normal appendix. Something must be found to account for symptomatology. Too frequently in the past, and I fear too frequently to-day, many of us were satisfied with the fact that we had operated and found nothing, and we did not try to find the real trouble. I shall mention a case in point: A nurse in one of our hospitals had, for a year, symptoms referable to the stomach. She had vomited persistently. She had pain beginning from an hour to an hour and a half after eating. She said that she had vomited blood. The history was suggestive of gastric ulcer. Stomach analysis did not confirm the suspicion; there was hypoacidity instead of hyperacidity, yet this, of course, did not disprove the diagnosis of cancer. One of the physicians in charge of the case suggested gall-bladder disease. At the same time we both realized that the appendix might be at fault. I operated with the idea that I would find a gastric ulcer, but an incision revealed nothing pathologic in the stomach. I investigated the gall-bladder region, but it, with the common and cystic ducts, was normal. I extended my incision downward far enough to explore the right iliac region and found a pericolic membrane and an appendix which did not look normal. I therefore removed it. Subsequent histologic examination of the appendix showed a chronic appendicitis. The patient had two definite pathologic entities, Jackson's films and a chronic appendicitis. A gall-bladder operation would have been absolutely useless because there was nothing wrong with the gall-bladder. The same was true of the stomach.

Then there is our responsibility to prevent infection; one of the first things we do is to get an aseptic field for operation. I take it that most of the profession depend to-day on iodin to sterilize the field for operation. How do we do it?

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Up to a year ago I had been in the habit of applying iodin when the patient was placed on the table. Many of my colleagues to-day are using that routine. A year ago I was unfortunate enough to operate on a case of double hernia which became infected on one side. The operation was clean and there seemed at first no reason for the infection. The infection occurred on the right side, on which I operated first. It did not occur on the left side. The only way in which I could explain that occurrence was that the iodin had twenty or thirty minutes longer on the left than on the right side. I therefore concluded that it was a mistake to operate immediately after applying the iodin; I now apply it twelve hours before operation. In emergency cases requiring immediate operation, we use gasoline for the first cleansing. It is dehydrating as well as cleansing, and is a better preliminary for iodin than soap and water.

Dr. H. C. Sharp, West Baden, Ind.: The leukocyte count is to me a very important additional guide as to the course the surgeon should pursue in acute abdominal conditions, especially that of appendicitis. The surgeon is frequently much in doubt as to whether immediate operation or treatment by the expectant plan offers the best chance to the patient. I have often found that when wavering on that point, the degree of leukocytosis has determined my course of procedure. When I find this acute condition with a leukocyte count of 16,000 or more, I feel well assured that the condition will go to suppuration, and that the wiser thing to do is to operate immediately, while if I find a low leukocyte count, say 10,000 or 12,000, I am reasonably assured that the patient will recover from the acute atack without suppuration, under the Ochsner method of treatment. I do not wish to be understood as advocating that the degree of leukocytosis should determine whether or not to operate in all cases, nor do I even present it to you as an established and unfailing fact that all acute cases of appendicitis, with a leukocyte count over 16,000 will suppurate, and that all cases with a count of 12,000 will not suppurate, but I have found it a valuable indication to assist in determining my procedure.

Dr. Joseph C. Bloodgood, Baltimore: We need more studies on the ultimate results of a large group of cases of the same lesion in which the question of diagnosis in the early stage and the operation which gives the best result should be considered. There are a number of reasons why we do not have that in this country. It is a very great labor and a great expense to consider a group of say five hundred cases and carefully sift the clinical evidence and the operative results. I know that that is true because I have paid for it myself. Nevertheless, we need such studies in this country and until we obtain conclusions based on such investigation we are not

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prepared for any uniformity in regard to the method of diagnosis and treatment in our cases. I believe with Dr. Ochsner that we must be careful about being definite, but so long as definite conclusions are checked up by the ultimate results, and these results show that diagnosis and treatment along those definite lines give better results, we must follow those lines. There will be an exception to every rule, but that exception in my experience does not injure the rule. We shall probably never reach the stage of exact diagnosis and treatment in every case, but we can improve our results; we must improve our results, if we wish to have patients come for treatment early. I have been so convinced of this that I wrote some friends of mine, asking for money. I said that I wanted to be able in four months to get the results of every case of cancer treated in Johns Hopkins in the last twenty years, and of every case of tumor of which I had a record in the laboratory. The first check to come in was for five hundred dollars, and feeling that more would come I began the work. I have had a group of ten volunteer students and three volunteer patients, and I find that it is going to cost me about four hundred dollars a month for four months. You can see the cost of an investigation of this kind. It seems to me that the clinicians in this country, spending hundreds of thousands of dollars on marble in their operating-rooms, might cut down on the marble and add to the force in the history room. We are not utilizing our medical students as we should. In Baltimore we have medical students who are getting only their board and lodging do this work because it is an education for them. I believe that in the future we shall be able to keep up the results of our work to date by volunteer students, without cost to the university, because the minute a student writes to Jones and Jones writes back that he is all right, that record is of living interest. The student looks at the history, he examines the tissues in the museum and the slides, and he has a record of the fact that John Jones, whose history and specimens show cancer, is well after twenty years. I think that we can get the hospitals which are spending too much money on unnecessary things to give some of it for clerical help to prosecute this study.

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FETAL PERITONEAL FOLDS

AND THEIR RELATION TO POSTNATAL CHRONIC AND ACUTE OCCLUSIONS OF THE LARGE AND SMALL INTESTINE

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Any one who examines repeatedly the abdominal cavity of the fetus after the peritoneum has formed is likely to be impressed by the loose manner in which this membrane is applied over the abdominal wall, anterior, posterior and lateral, and over some of the abdominal viscera as well, and thereafter probably will not look on the presence of an anomalous peritoneal formation in the adult as a singular phenomenon.

In the fetus, particularly in the neighborhood of the cecum, folds of peritoneum may be picked up freely from the posterior and lateral parietal serosa. In the region of the caput coli and ileocecal junction, however, there appear frequently after the fifth fetal month certain peritoneal folds of fairly constant form and distribution which stand forth without manipulation and spread out so prominently that they can scarcely be overlooked. They are either anatomic or pathologic entities, and surely are not brought into existence by any artifice of traction or manipulation.

Some of these folds present in the fetus characteristics which suggest strongly their relationship to adult pathologic states which are dependent on peritoneal anomalies or abnormalities; for example, those sheets of peritoneum which lie on and compress the cecum and the ascending and transverse colon which Jackson, who first

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described them, called "pericecal membranes." In the fetus may be found frequently sheets or broad bands of serous membrane which pass from the mural peritoneum over the front of the cecum and ascending colon, sometimes greatly lessening the caliber of this part of the large intestine. These are the bloodless fold of Treves and the parietocolic fold. The latter, according to Douglas Reid, was first described by Jonnesco. It resembles the pericolic membrane of Jackson as seen in children and adults.

Other fetal folds suggest by their position and attachments a causal relationship to gravitations and angulations of the terminal ileum. For example, the genitomesenteric fold described by Douglas Reid of the University of Cambridge, a fetal fold which passes from the mesentery of the terminal ileum down into the pelvis attaching below to the genital gland, bears an interesting resemblance to the so-called ileopelvic band, an anomalous band occasionally passing from the terminal ileum into the pelvis in the adult, to which Mr. Arbuthnot Lane ascribes an important rôle in the causation of Lane's kink. Figures 1, 2 and 3 show the genitomesenteric fold of Reid. These are photographic enlargements of smaller photographs sent to me by Mr. Reid, and are part of a set similar to that recently accepted by Professor Keith for the Royal College of Surgeons.

Mr. Lane himself does not attach great importance to this apparent relationship. In a personal communication he states that he does not consider that the band which produces ileal kink can be regarded as to causation apart from the innumerable adhesions which later develop into what Mr. Lane calls "mesenteries," and which oppose, in his belief, the descent of the several intestines; in the first instance to their functional advantage, subsequently too often to their functional disadvantage. Mr. Lane observes that calling these several bands by different names in no way explains their simple

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mechanical causation. He speaks[1] of these membranes as crystallizations of resistance to displacement of the intestine.

I wish to disclaim intention to question these statements given from so eminent an authority, but respectfully submit some observations which, while they may seem on casual review to be in conflict with the attractive explanation of the presence of these so-called mesenteries as given by Mr. Lane, will, I hope, invite the interested attention of those who seek to know everything important or unimportant that pertains to the cause of the presence of anomalous peritoneal membranes in the adult.

The crystallization of resistances must, if we accept Mr. Lane's explanation, begin in the embryo, or almost as soon as the peritoneum is formed, for some of these folds may be said to be almost anatomic, since they are fairly constant structures in the fetus. Many bear the names of the anatomists who first described them, for example, the folds of Hueschka, Reid, Treves, Jonnesco and Juvara. Singularly, the genitomesenteric fold of Reid, which I believe to be the fetal forerunner of Lane's ileopelvic band, is one of the most constant of these folds. In view of the frequent observation of narrowing of the cecum and ascending colon by contracting anomalous bands of peritoneum, we suspect it is possible that the downward displacement of the terminal ileum may be brought about by a similar contraction of the genito-mesenteric fold of Reid.

Reid's genitomesenteric fold is continuous above with the duodenorenal ligament of Hueschka, and we have here at least a speculative explanation of the kinking upward of the terminal ileum. Another fold not above suspicion in cases of upward displacement of the terminal ileum is the rather constant ileocolic fold which, if contracting, would draw the terminal ileum upward and toward the ascending colon (Fig. 4.). Likewise the

1. Lane, W. Arbuthnot: The Consequences and Treatment of Alimentary Toxemia from a Surgical Point of View, Proc. Roy. Soc. Med., March, 1913, vi, No. 5.

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so-called root folds, as the left or superior root fold shown in Figure 5, or the right root fold, the mesentericocecal fold of Jonnesco, which are ridge-like upward reflections of the mesentery, indicate the marked tendency to irregularities of attachment and upfoldings of the mesentery.

I have had little difficulty in finding Reid's genitomesenteric fold in fourteen out of thirty-two fetuses examined (Fig. 6). I have also been able to demonstrate it in the adult where it had caused a kink and where it had produced no kink of the ileum. By picking up the terminal ileum in an adult, a tall, sickle-shaped fold of peritoneum passing from the mesentery of the terminal ileum to the internal abdominal ring came up much too freely to admit of suspicion of its having been produced by traction. Reid likewise has demonstrated the genitomesenteric fold in the adult. Illustrations in one of C. H. Mayo's published articles show a band corresponding precisely to Reid's fold which he divided for the correction of a Lane's kink.

Mr. Lane[2] describes his ileopelvic band as a new or acquired distinct peritoneal ligament which attaches itself progressively to an area of the ileum more and more distant from the attachment of the normal mesentery. If Lane's ileopelvic band is not a persisting fold of Reid, it is an interesting coincidence that the fetal structure should be precisely similar in its position and attachments to the adult band; and if, as Mr. Lane says, and as I have no sufficient reason to question, this fold is due to a crystallization of forces to resist the descent or displacement of intestines, then this crystallization surely takes place in fetal development.

In the case of the genitomesenteric fold, a simple if somewhat suppositional explanation of origin is that in the descent of the right ovary or testis the dorsal peritoneum is caught and dragged or drawn out into this form.

2. Lane, W. Arbuthnot: Brit. Med. Jour., May 4, 1912.

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It is not a contradiction of Mr. Lane's position to say that the anomalous peritoneal formations of the adult may be found with rather interesting constancy in the fetus, whatever their purpose and aim may be.

If we take for example the bloodless fold of Treves, we shall find that, even in the early stages of its formation, it appears to resist movement of the cecal head; that is, its position and attachments show that it must tend to resist cecal torsion (Fig. 7). In Huntington's "Anatomy of the Peritoneum," p. 241, will be found a description of cecal torsion:

> When the cecum has come down from its hepatic position, the terminal coils of the ileum pass from right to left behind the cecum to enter the colon, and the concavity of the cecal pouch is directed upward and to the right. After the final act of rotation has occurred, that is, after the cecal torsion has taken place, the ileum enters the large intestine from the left and from below, and the concave border of the cecum is directed to the left. This change in relative position has been accomplished by a revolution of the colon and cecum through an arc of 180 degrees around its own axis, carrying the cecum above and behind the small intestine, and bringing it into contact with the dorsal prerenal parietal peritoneum. At the same time the terminal coils of the ileum turn downward and to the left. If this final step in rotation of the large intestine fails to occur, with otherwise normal development of the parts, the ileum will persist in entering the large intestine from right to left after the cecum has obtained its final lodgment in the right iliac fossa.

There is considerable evidence to support the assumption that the bloodless fold of Treves begins as an adhesion between the cecal head and the mural peritoneum, as shown in Figure 7, and that later in the act of cecal torsion the caput coli rolls itself, so to speak, in serosa drawn over from the very loosely applied peritoneum of the lateral abdominal wall, as a man rolls himself up in a blanket; for the bloodless fold of Treves may be found as a short band of adhesion, as shown in Figure 7, as a somewhat longer band as shown in Figure 8 (dissection of an adult by Reid), or as a sheet long enough to extend from the lateral abdominal wall, beginning at a point

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opposite or below the level of the cecal head, and extending upward and inward, to be attached to the mesentery of the terminal ileum, and forming a shirt-pocket-like fossa in which the caput coli and vermiform appendix may lie ensconced (Figs. 9 and 10). It seems fair to suspect that the parietocolic fold is formed by similar fusion at a higher level.

It may fuse with the peritoneum covering the caput coli. I believe that the bloodless fold of Treves not rarely persists in the adult, and forms the boundary of a precolic fossa in which the cecal head and appendix may be tightly embraced (Fig. 9); and further, that during operations for appendicitis, it is likely that the caput coli with the appendix is not rarely shelled out of this anomalous peritoneal pocket; the peritoneal membrane, that is to say the bloodless fold of Treves, which forms the pocket, being looked on by the operator as an affair of adhesion formation.

Another rather common fetal fold which, persisting and contracting, may bind down the appendix or envelop it, is illustrated in Figure 11. Here a skirt-like fold passes from the terminal ileum above, downward around the appendix, embracing the basal half of the appendix, and then passing upward is inblended with the serosa of the caput coli. The appendix rests in this fold like a man seated in a hammock, or like an injured forearm placed in a sling. (Fig. 11.)

I have been more and more impressed with the probability of a certain percentage of pericecal membranes which appear at a higher level on the ascending colon in the adult likewise owing their existence to adhesion between the descending caput coli and the mural serosa. If, while the cecum is in its subhepatic position, it should become adherent to the mural serosa in descending and rolling inward, as it does in normal torsion, it would draw the parietal serosa over in front of the ascending colon in a slanting or spiral direction, like a ribbon

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wound spirally across or around a rolling cylinder, and we should recall that in the fetus the parietocolic fold of Jonnesco often assumes such a slanting direction, crossing the ascending colon from above externally to below internally. Then, too, we should note that Douglas Reid and Byron Robinson have called attention to adhesions of the colon to the peritoneum of its own mesentery. That is to say, along the line where the lateral mural peritoneum passes over to become the peritoneum of the outer lamina of the mesentery of the ascending colon, it first passes up for a short distance, as an upward reflected fold adherent along its upper border to the ascending colon laterally, then passing down and again upward and around over the ascending colon to form its normal peritoneal covering. I have seen in operations on the adult the peritoneum of the mesentery of the ascending colon reflected upward and adherent to the colonic peritoneum for a distance of 5 or 6 inches. As it was also seen by Douglas Reid in the fetus, it does not seem unfair to suspect this upward reflection of the mesenteric peritoneum of being a persisting fetal adhesion. We have here presumptive evidence that Jonnesco's fold or the parietocolic fold is due to adhesion between the cecum and the mural serosa before cecal torsion has taken place, and that with subsequent rolling inward a sheet of peritoneum is drawn from the lateral abdominal wall as it rolls from left to right.

Reid describes two cases in which the parietocolic fold was formed by a large appendix epiploica. The first step in the development of the parietocolic fold and of the bloodless fold of Treves may be made clearer by assuming that before cecal torsion takes place a large appendix epiploica or several appendices epiploicae become adherent to the parietal peritoneum and elongate and spread out as the colon rolls over from right to left. Indeed, it is difficult to understand how an adhesion between the

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colon and the mural peritoneum could occur except through an appendix epiploica catching on the rotating cecum and dragging up the mural serosa after it, inasmuch as before cecal torsion is complete the colon and mural peritoneum are separated by coils of intestine which lie in front of the colon below that part which is covered in front by the liver. At the right side lies the appendix, which, it should be noted, is proportionately very large in the fetus. It forms a loop at the side of the colon and cecum. The appendix with the mesoappendix completely separates the colon from the peritoneum at the right lateral abdominal wall. Reid remarks that at this stage of cecal torsion it appears to be impossible for any adhesion to form between the colon and the lateral abdominal wall except through the medium of an appendix epiploica.

In the literature on membranous pericolitis there are reports of many cases of chronic intestinal stasis induced by the fettering and constriction of the cecum and ascending colon by the cobweb-like peritoneal sheets and bands to which attention was first called by Dr. J. N. Jackson. It has been clearly shown again and again that arrest of movements of the large intestine and compression of its lumen may be caused by contractures of this anomalous membrane.

So far as I am aware, however, no causes have as yet been reported in which a pericecal membrane completely strangulated the large intestine, producing acute obstruction with ileus. That extensive pericecal membrane formation may lead to acute complete obstruction was shown by the following observation:

Jan. 18, 1912, R. H., aged 24, was admitted to the surgical service of the Indianapolis City Hospital with a provisional diagnosis of acute obstruction of the bowel. He had become ill three days previously with colicky pain in the abdomen and vomiting. The vomiting had persisted for the three days. It had been impossible to move the bowels during these three

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days, and no flatus was expelled, notwithstanding the free use of enemas. On failure to obtain results from high enemas after his admission to the hospital, the abdomen was opened, and I was able to demonstrate a tight compression of the ascending colon, as illustrated in Figure 12. A distinct, smooth, continuous sheet of anomalous peritoneum was not present. The membrane was web-like, and to some extent loculated. There was little doubt, however, that it was an anomalous peritoneal covering which was continuous with and passed from the mural serosa, over the ascending colon, to be inserted in the inner side of the mesentery of the ascending colon, for the blood-vessels passed freely from the membrane onto the mural serosa. There was no sign of infection or inflammation anywhere in the abdomen. There was, however, a small amount of thin, straw-colored fluid which was taken to be a product of secondary peritoneal reaction to the obstruction and distention of the intestine proximal to the constricting membrane. The membrane was split up with scissors on the operator's finger as a guide, passed between the anomalous membrane and the normal peritoneum of the ascending colon. Coincidently, this segment of the large intestine being released, it drew, as it were, a long breath, filling up promptly with gas from the ileum and ballooned cecal head. It promptly became a thoroughfare again, as was announced by the rumbling of gas. The man recovered duly, and up to the present has had no recurrence of his trouble. I have twice seen in the fetus a pericolic membrane tightly compressing the ascending colon (Fig. 13).

It should be stated that the fetal folds as shown in these photographic enlargements do not stand forth clearly as they do in the fresh specimens, the photographs having been made from specimens prepared in Kaiserling's Number 211 and glycerol (glycerin) and preserved in paraffin oil. The filmy gossamer folds flatten and contract in the preserving solution. To receive a correct impression of them one must look into the abdomen of the fresh fetus at or near full time. If viewed under these favorable conditions, these delicate web-like bands and gauze-like winding-sheets on the cecum cannot fail to interest any one interested in intestinal pathology, or to arouse his suspicions as to their connection with abnormal peritoneal folds of the adult.

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Fig. 1.—The genitomesenteric fold of Reid. The white sickle-shaped band is seen passing from the terminal ileum down into the pelvis.

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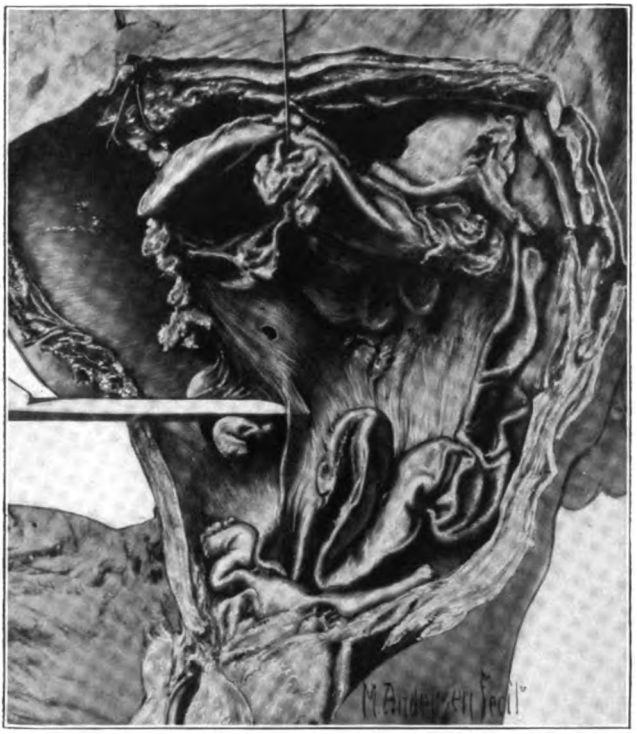

Fig. 2.—A genitomesenteric fold of Reid passing upward from the genital gland to the mesentery of the terminal ileum.

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Fig. 3.—The genitomesenteric fold of Reid. A heavy band passing from the terminal ileum into the pelvis.

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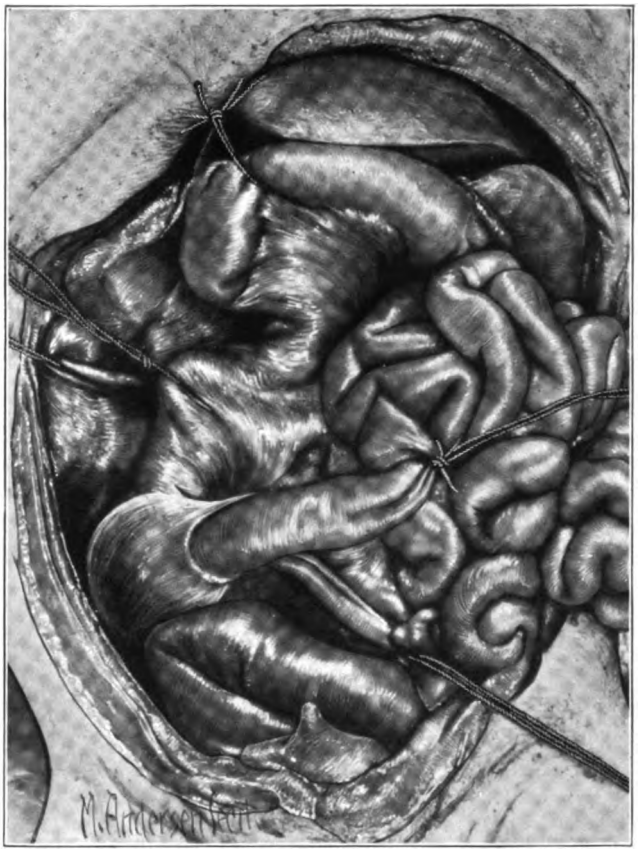

Fig. 4.—The ileocolic fold extending from the upper lamina of the mesentery of the terminal ileum around over the cecum.

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Fig. 5.—The superior root fold (after Douglas Reid).

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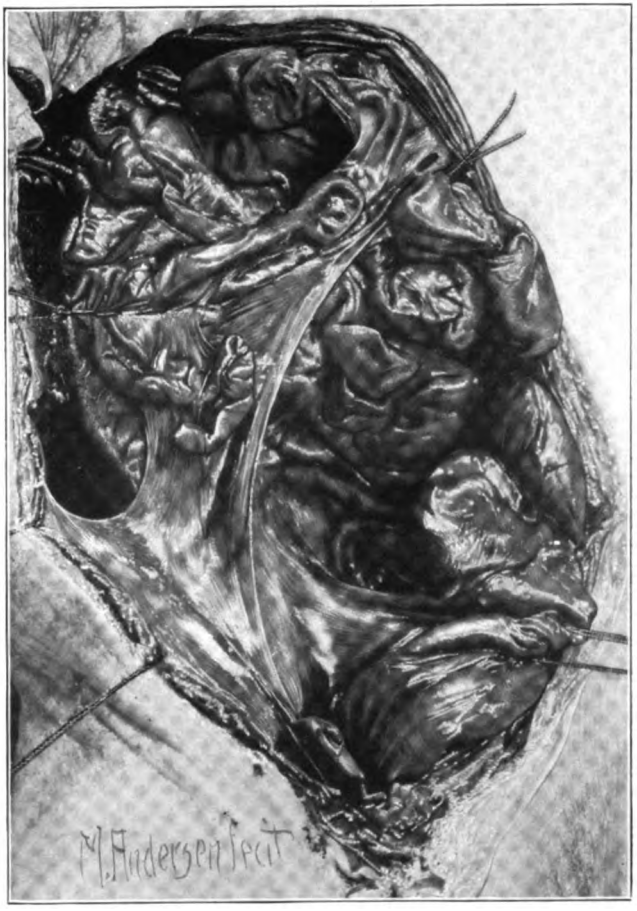

Fig. 6.—The genitomesenteric fold of Reid is the sharp sickle-shaped band at the right of the picture. Laterally to this band is the bloodless fold of Treves passing from the mural peritoneum to the caput coli.

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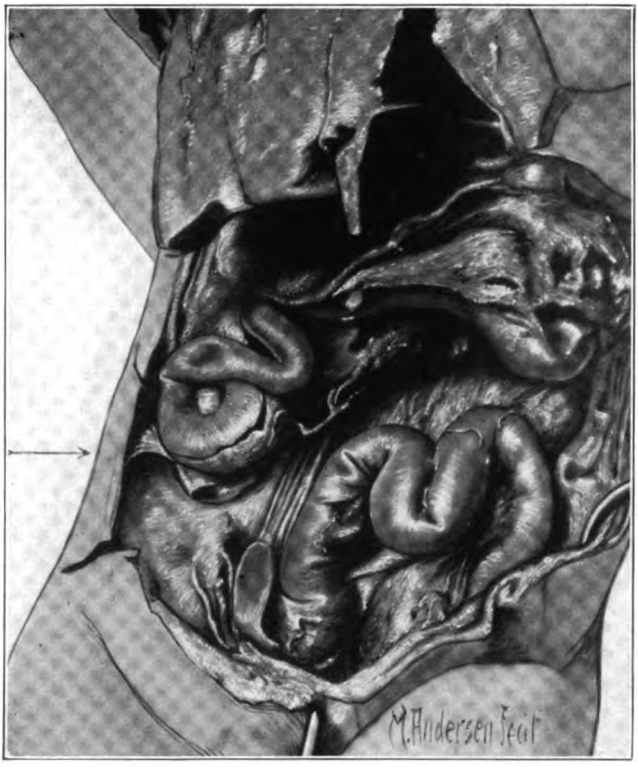

Fig. 7.—A beginning bloodless fold of Treves being formed by the stretching out of an adhesion forming between the caput coli and mural peritoneum before normal cecal torsion (after Douglas Reid).

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Fig. 8.—A bloodless fold of Treves somewhat more fully developed than the narrow adhesion-like fold in Figure 7. (Enlargement of photograph by Reid.)

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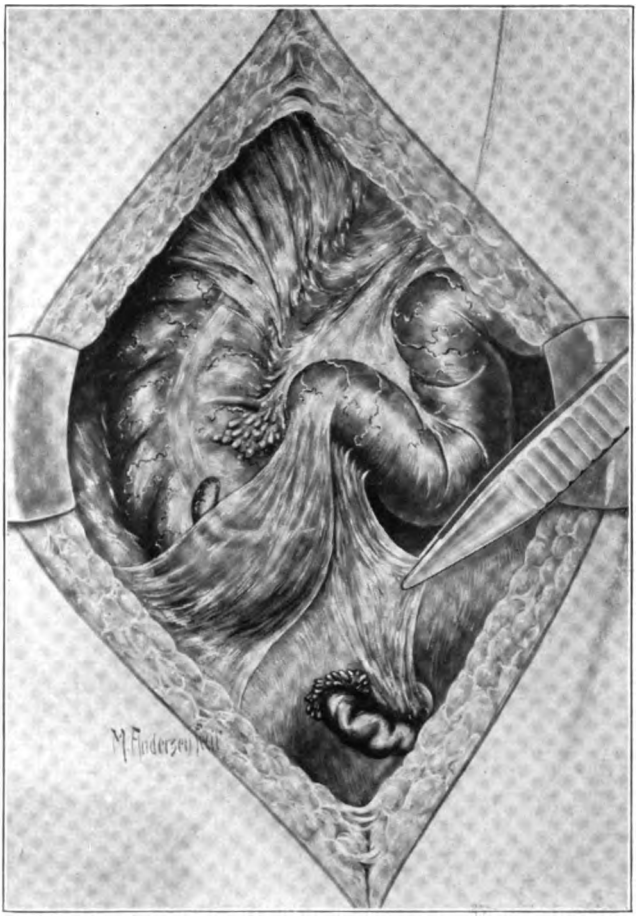

Fig. 9.—Above, the parietocolic fold of Jonnesco passing from the mural serosa across the ascending colon to the inner lamina of the meso-colon. Below to the left the bloodless fold of Treves forming a sconce from which in adults the caput coli must occasionally be shelled out. To the right below the genitomesenteric fold of Reid.

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Fig. 10.—The bloodless fold of Treves passing from the mural serosa to the cecum.

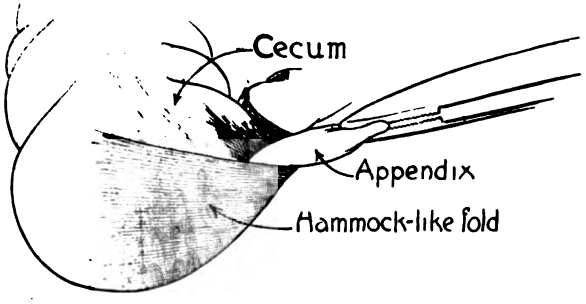

Fig. 11.—A fold passing from the terminal ileum around and below the vermiform appendix and passing upward over the caput coli. The appendix lies in this fold like an injured forearm in a sling.

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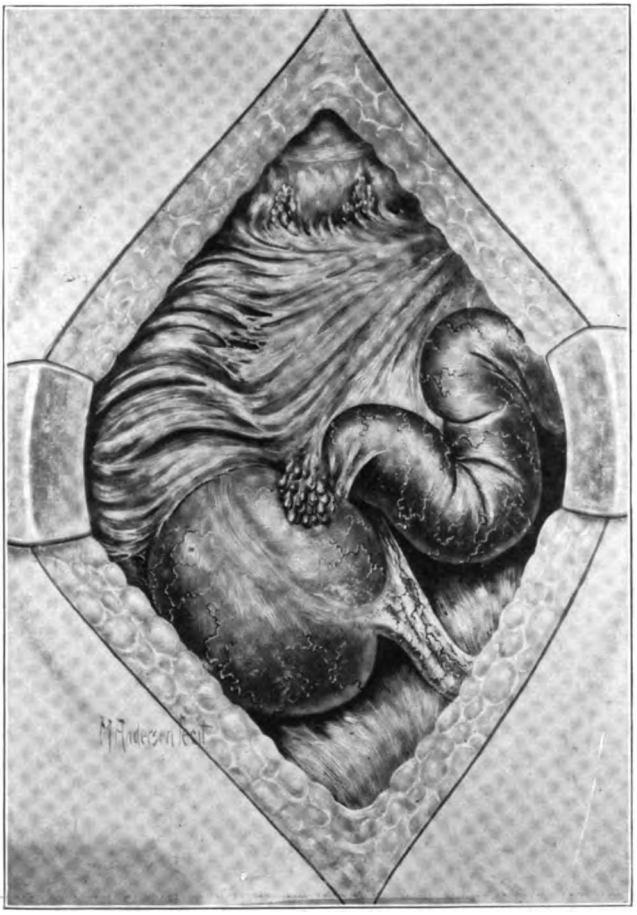

Fig. 12.—A parietocolic fold or Jackson's membrane which produced an acute complete obstruction of the ascending colon with ileus. Blood-vessels passed freely from this anomalous sheet over on the mural peritoneum.

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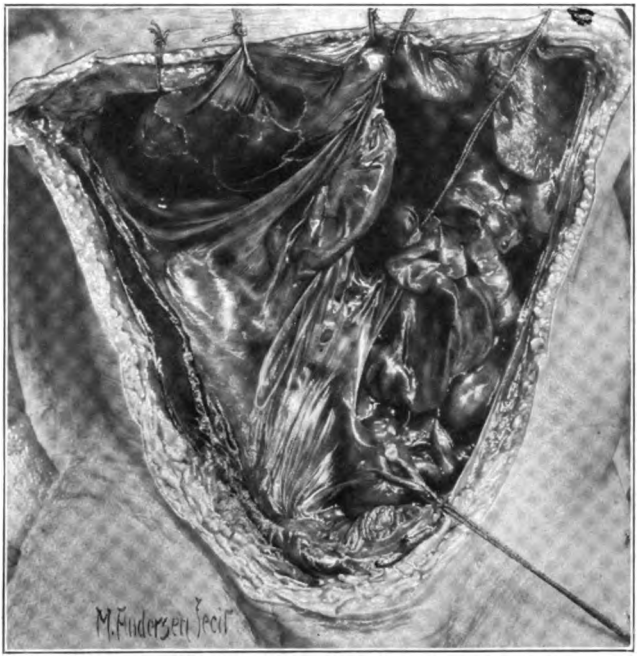

Fig. 13.—A parietocolic fold producing strangulation of an ascending colon in a fetus, a condition strikingly similar to that observed in an adult and illustrated in Figure 12.

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SURGICAL ASPECTS OF INTESTINAL STASIS, FROM AN ANATOMIC POINT OF VIEW

JOHN E. SUMMERS, M.D.
OMAHA, NEB.

It seems to me that it would be like carrying coals to Newcastle to attempt to discuss the subject of intestinal stasis in any but a restricted sense. Much has been written about intestinal stasis, from the points of view of both the physician and the surgeon, but nothing of great importance has been added, throwing light on it, from the surgeon's standpoint, which has increased our knowledge beyond that which we received from Lane and Jackson. Lane may be an extremist and his surgery may need some toning down, but his deductions are based on sound premises. Jackson made a great discovery in his "pericolic membrane," and his clinical diagnosis of its presence and the attending pathology has not been improved—it is standard.

During the past year two notable papers have appeared, one by Flint, in the Johns Hopkins Bulletin, and the other by Rilus Eastman (*Journal of Surgery, Gynecology and Obstetrics*), read before the Western Surgical Association, which settle conclusively the mooted point as to the origin of the much-discussed peritoneal bands and membranes of Lane, Jackson, Jonnesco, Reid, Treves and others. They are all congenital and have been recognized and described by anatomists for generations, but that any one of them had a clinical significance other than in the formation of fossae for the possible development of retroperitoneal hernia, appears to have escaped attention until Lane and then Jack-

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son recognized and demonstrated the fact. Lane himself says that after he had called attention to the mechanics of chronic intestinal stasis, the existence of the membranes and bands which he is pleased to designate "acquired mesenteries and adhesions" were "absolutely and categorically denied by physicians experienced in post-mortem work, who appeared to think that, because they had escaped their observation as many things have done and will continue to do, they were justified in denying their existence in the most dogmatic manner possible."

Last summer I had the opportunity of seeing and examining some of Mr. Lane's patients before operation, witnessing his work and examining and talking with some of his patients who were convalescent from operations for the relief of chronic intestinal stasis. So favorably was I impressed with the reality of the subject that during the past year I have sought every opportunity for enlightenment as well as a critical study of my own patients, in order to come to some conclusion for myself as to the frequency of the membranes and bands considered responsible for the symptoms of intestinal stasis from its mildest to its most severe forms. In my experience as I have gained better opportunities for observation through longer incisions, I have come to the conclusion that membranes of the pericolic type of Jackson may be found in every abdomen, if not on the right side in the lower, middle, or upper quadrant, then in the lower left quadrant. We must ever bear in mind that in great measure, the relative relations and displacements of the viscera depend on the conformation of the skeleton, and that there are quite as great variations in the abdominal viscera as there are in the faces of their owners. As before stated, these delicate membranes which we find about the ascending colon, ileum, cecum, involving or not the vermiform appendix, have been described by anatomists for generations. It is the rule rather than the exception that when they do produce symptoms it

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is in adults, and not in children. Many times the adults are beyond 50 years of age, and up to the time of the commencement of the symptoms, there has never been a sign of anything wrong within the abdomen that could be attributed to the membranes. Therefore these membranes should be regarded as purposive rather than offensive. All of the different types of these membranes may early become offensive, producing angulations of the bowel with their necessary consequences. These instances are congenital defects the same as are cleft palate or supernumerary toes. Continued abuse of function, particularly of the cecum and ascending colon, results in loss of tone, and the membranous supports always present in greater or less extent in every individual, instead of being conservative, become restrictive in the same sense as I have shown elsewhere that the chest wall hinders the action of the damaged, tethered heart in adhesive mediastinopericarditis, and that the overlying ribs should be removed in order that the heart may functionate with less strain. Displacements and angulations of the intestines resulting from peritonitis, localized or more or less general, bear no relationship to any special clinical history, and each is a law unto itself; whereas the different disturbances connected with congenital membranes of the type under consideration all have a rather definite history, which can be recognized by the man of keen wits, and when the symptoms cannot be relieved by a careful study and regulation of the diet. and the use of a mechanical laxative such as paraffin, these cases become surgical. The last word has not been said as to the best technic to be followed in any individual case. Some of Mr. Lane's work appears too radical; among neurasthenics, I believe his technic of ileosigmoidostomy will sometimes fail if a catarrh of the mucomembranous type is present, unless there is added a fistula into the cecum for long-continued irrigation of the colon. In a paper which I had the honor to read before the Chicago Surgical Society, March 6, 1905,

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entitled "The Surgical Treatment of Chronic Mucomembranous and Ulcerative Colitis, with Special Reference to Technic," I advocated strongly the operation of Monprofit, in exclusion of the colon; it is known as "exclusion with drainage into the intestine," and is intended chiefly for obstructions in the colon. The ileum is divided far enough away from the ileocecal valve so that the divided ends can be implanted into the colon—the proximal end above, the distal end below, into the sigmoid or pelvic colon. In spite of theoretic objections to the contrary, the fluids from the excluded part of the colon drain through the ileocecal valve into the stump of the ileum, on into the sigmoid flexure. It would seem an improvement over this method of Monprofit's, if employed in chronic intestinal stasis, that instead of dividing the lower ileum, it be approximated to the sigmoid and two anastomosis openings made; between these openings the ileum should be occluded by a purse-string suture, and both limbs fastened to the sigmoid so as to close any opening that might permit of a loop of intestine becoming strangulated. In ileosigmoidostomy, reliance on Lane's last kink, congenital or artificially made, never appealed to me, because in this situation the intestinal wave is antiperistaltic, which was so beautifully demonstrated by Cannon years ago. This kink will hardly prevent a backward flow into the colon; if not competent to do this, the valve will dam back the accumulated feces above, since the *vis a tergo* and peristalsis have been removed by diverting the intestinal flow from the ileocecal valve.

Where the cecum and sigmoid are sufficiently mobile, an anastomosis between them seems a practical solution and a relatively mild procedure. The paper above referred to as read in Chicago was based on my experience at that time, of eight cases operated on for chronic mucomembranous colitis. Four had a Gibson fistula made into the cecum for irrigation, and two had, in addition, the ileum divided, the lower segment occluded

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and the upper implanted into the sigmoid. One of my operations was after the technic of Maisonneuve. In these operations the appendix was removed, as the mucomembranous colitis was supposed to be secondary to a chronic appendicitis. My knowledge and recollections to-day tell me that the true reason of the inflammation was an intestinal stasis (our old-fashioned auto-intoxication), a Jonnesco-Reid genitomesenteric fold aggravating the difficulty. Removal of the colon is too hazardous an operation if an intestinal exclusion operation can be carried out in a successful way. The cecum, especially when not supported by a parietocolic membrane, may be large and mobile. In 30 per cent. of adult people with a large mobile cecum, symptoms referable to this condition are clinically present. The symptoms are present *not* because the cecum is large and mobile, *but* because its walls are flabby and it has lost the power of emptying itself properly. The condition is corrected by a plication operation, supporting the cecum or not, as indicated. The common ptoses of the transverse colon, sometimes into the pelvis, resulting from neglected function of the congenitally weakly supported viscus, are well handled after the technic of Coffey. As a rule most congenital membranes of the pericolic type are best released at their loosest line of attachment by passing some blunt instrument under the membrane along this line and dividing it. In other cases in which greater mobility seems desirable, the compressed intestine should be rotated toward the middle of the abdomen until a white line is observed on the posterior lateral wall of the abdomen, which is the line of fusion of the colonic peritoneum with the parietal peritoneum after rotation of the ascending colon has been completed. This is also the attachment of the pericolic membrane to the parietal peritoneum, and is the strongest line of attachment of this *ligament;* it should be divided along this line. This will give the greatest amount of motility and require the least amount of peritonization.

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Wherever the membranes of the type under discussion are situated, if tension be made on the attached hollow viscus in a direction continuous with the course of the blood-vessels and fibers of the membrane, a white line will always be observed; this is the ligamentary attachment of the membrane to the parietal peritoneum, or to the peritoneal investment of a solid viscus.

In our citizenship, made up of a heterogenous mixture, with "no thought for the morrow," like does not produce like in a possible totality. Sprouts, buds and offshoots appear in all grades of potentiality. Many more bodies are examined *in vivo* than in the deadhouse, giving better opportunities for comparison of the types of frequency of variations from supposed anatomic standards. The accumulating evidence offered by the study of the pathology of the living will make great strides in the recognition of normal anatomy before the end results of disease have obscured it.

I would like particularly to ask discussion on the following points:

1. If the Jonnesco-Jackson-Reid membranes are congenital, are they always more or less clearly demonstrable in every individual, should the incision admit?

2. Are the membranes purposive? If so, are they not intended by Nature as ligamentary supports—preventive of intestinal stasis rather than causative?

3. Therefore they should be divided only after they have become restrictive of intestinal function, from loss of nervous and muscular tone resulting from chronic intestinal toxemia.

4. Is the method of demonstrating the white line always reliable? If so, does not this in itself prove the congenital origin of the membrane and its physiologic importance?

3624 Dewey Avenue.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. EASTMAN AND SUMMERS

DR. M. L. HARRIS, Chicago: For some time past I have been operating on a large percentage of my patients under nerve-blocking by means of some combination of novocain. Without going into a discussion of the advantages of local anesthesia over general anesthesia, I wish to call attention

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to the great advantage which local anesthesia has in affording opportunities in abdominal operations to demonstrate the origin of many symptoms which we have learned to recognize clinically, but which we have not always referred to the proper cause. After blocking the nerves of the abdominal wall and opening the abdomen, we may then reproduce, by a variety of procedures and manipulations, characteristic pains and thereby learn positively the cause of the particular pain in question. In operating in the region of the appendix it is easy to demonstrate that the appendix is insensible to any form of mechanical manipulation or injury. It may be crushed, incised amputated or cauterized and the patient gives no evidence of pain; but traction on the mesentery of the lower end of the ileum instantly produces the characteristic epigastric or umbilical pain of which many patients with chronic appendicitis complain. In the same way we can produce the sensation of nausea, and these patients can be made to gag and even vomit by certain manipulations of the mesentery about the appendix. We can reproduce the typical pains of inflammations of the other abdominal organs in this way. This is also true in cases of pericolic membrane of whatsoever nature. We can reproduce the same characteristic, general diffuse pains of which these patients complain, not by touching the pericolic membrane itself, because that is insensible, not by manipulation or making traction on the colon, which is likewise insensible, but by making traction on the membrane itself where it is attached to the parietal wall. This is true also of the gall-bladder and the stomach. What I wish to call attention to here is that the epigastric pain, the pain or sensation of nausea and vomiting, which is present in these chronic cases, is an intestinal pain, pure and simple. It is produced by injury to the nerves going through the mesentery. The diffuse pain, the general pain, is due to interference with the parietal nerves. In circumscribed adhesions the pain may be circumscribed, but it is due to involvement of the parietal peritoneum.

Dr. H. A. Royster, Raleigh, N. C.: Inasmuch as these papers have opened up the subject of peritoneal folds, I desire to call attention to what I think is an important addition to this question. Folds and kinks, membranes and veils, are the order of the day. So far those which have received names are on the right side. We have the Jackson veil, the Lane kink, and "cobwebs in the attic," but if we go farther and follow the large intestine around, we shall find that the splenic flexure gives us some trouble, and I wish particularly to mention the "sigmoid adhesion." Nowadays we think only of right-sided pain, or we try to account for the pain by finding something wrong in the right side of the abdomen. We do not know in any given case which adhesion is going to fit until we have opened the abdomen. I think that many of

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us are having a great deal of trouble to explain left-sided pain, particularly in the case of women patients, because the pelvis enters into consideration. My study was directed particularly to this subject of left-sided pain in women, and, on investigation, I found that the sigmoid played a tremendous rôle in these cases. The ovary was too often blamed for the trouble. When we opened the abdomen we found a condition which we did not suspect, and, more than that, one which we did not know at first how to deal with. The etiology does not bother us nearly so much as the solution. It does not matter much whether these pains are anatomic, physiologic or pathologic. They must be dealt with if they are causing symptoms. I would suggest, however, that these conditions, if pathologic, are simply exaggerations of an embryologic or a normal condition. The symptomatology of sigmoid adhesion is a rather negative one. An important point is that the patients complain of pain on the left side during defecation. They are more or less constipated, the constipation alternating with a mucous diarrhea in some cases. In women the question of pelvic pain enters largely into the consideration of the case, with or without the sigmoid adhesion. I have ready for publication a short paper dealing with this question and the methods of handling these adhesions. I first described it four years ago. It is merely a matter of cutting the adhesion across and then suturing in a longitudinal direction. This draws the sigmoid away from its abnormal or exaggerated normal position. This may explain many conditions on the right side; I have seen a distended large bowel due entirely to sigmoid adhesion, while lesions on the right side were not present. If you are considering these intestinal folds, look on the left side and you will find a distinct clinical entity which must be relieved.

Dr. A. A. Law, Minneapolis: I do not agree with Dr. Royster that we can ignore the etiology of membranous pericolitis. As scientific men we should investigate the etiology and attempt to solve it. It is a pity that we cannot all agree with Dr. Eastman's theories. I do not presume to advocate any one theory. We must give all the theories cognizance. If the embryonic theory is correct, why do we not find these membranes in children? I have never seen membranous pericolitis in a child. My youngest patient, and I reported thirty-one cases, was 18 years of age. This is significant, for it would seem that, with the large amount of abdominal surgery being done on children for other conditions, some observer would report finding membranous pericolitis. It is only after a mass of evidence has been presented and sifted that we shall be able to arrive at a definite conclusion. I have reported thirty-one cases of this pseudoperitoneal membrane and in every one roentgenographic

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studies were made after the ingestion of bismuth emulsion by mouth or its injection into the colon. This number of cases is, of course, too small to be of much value, but some of the points learned from the study are valuable. In every one of the cases there was cecal atony and ptosis. In every one the cecum was in the pelvis. If cecum mobile was not present at the time of operation, it was created when these membranous bands were released. Whether this is of significance, whether this ptosis of the cecum antedated the formation of the membrane or not, I do not know. In every instance except one, gall-stones or appendicitis was present. This would seem to confirm Gerster's and Pilcher's contention that the condition is due to a chronic poisoning secondary to fecal stasis in the cecum, for here with the dilated, atonic intestinal wall the musculature is unable to lift its fecal load over the hill of the hepatic flexure. This theory seems to me the most tenable.

Dr. D. N. Eisendrath, Chicago: There is absolutely no question that Jackson and Eastman have both made exceedingly valuable contributions to the subject. There is a pericolic membrane. Whether this membrane is of embryologic or acquired origin is an open question. I have come more and more to the conclusion, after observing a large number of cases clinically and making dissections not only on the human fetus but also on the dog and other animals, that this fold of Jonnesco is an embryologic structure which persists throughout life and which may give rise to conditions of undoubted pathologic significance. In about seventy laparotomies I have seen that this fold of Jonnesco is not, as Summers says, always identical with the colic mesentery. It is a separate membrane. In one of my cases the membrane passed across from the parietal wall of the peritoneum. It had the typical spiral twist and you could put a finger under the upper end of the membrane and lift it up separately from the colic mesentery. Since then I have observed it in a large number of patients who have not complained of any symptoms. On the other hand, I have operated on patients in whom this membrane caused a complete stenosis of the ascending colon. I think that there is no question but that this membrane is present in its embryonic form in almost every individual. Some surgeons may be impressed with the idea that Jackson's membrane is always a pathologic structure and strip it off violently, leaving many bleeding points. The patient will then surely have postoperative symptoms. There are a certain number of patients with chronic appendicitis who do not recover as we would wish them to do and these patients may have a Jackson membrane (fold of Jonnesco) which has undergone pathologic changes resulting in kinks or constrictions of the colon. Jackson and Summers both emphasized the point that one should not be content with a pin-hole incision, but

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should make an incision large enough to permit a good view of the entire ascending colon; then no pathologic condition which may be present and which otherwise may escape notice will be missed.

Dr. J. N. Jackson, Kansas City, Mo.: I have no fixed view as to the origin of these adhesions or bands; that is a point which awaits final determination. I have been amused to hear men say that this condition is congenital and therefore does not amount to anything. Doctors do not ignore a case of congenital club-foot, but try to remove this condition. Whether or not we regard the peritoneal fold as congenital, whether or not it is this fold which Dr. Eastman described, we know that it is a membrane holding down the intestine and that the one thing to do, therefore, is to make traction on the bowel and where the line shows sever the membrane and ligate the stumps to prevent a recurrence of adhesions when healing takes place. On the other hand, if the theory of Gerster is correct, that there is primarily a colitis and that the disease begins on the inside, the membrane should be cut in the same way and stripped off, because otherwise the condition cannot be cured and there is always the possibility of reproduction of the membrane. It is evident, then, that we must deal with the factor of the reproduction of that membrane. Hall's theory was that it was not a colitis, but a condition due to the passage of toxins through the bowel, which lifted the peritoneum and resulted in the formation of this membrane. If it be due to anything that started within the bowel, we must do something more than divide the membrane. We must make a cecal fistula, do an appendicostomy, a short-circuiting operation or a transposition of the cecum into the upper rectum; even though the ileum be shifted, this material will be brought back by antiperistalsis, which should be excluded; this procedure is therefore not always effective. The cecum has no membrane ordinarily that would cause a collection of gas and a distention of the bowel, and thus produce traction of the peritoneum which produces the symptoms which I described.

Dr. J. R. Eastman, Indianapolis: I agree in the main with what Dr. Law has said. He has an erroneous impression, however, as to my conception of the origin of pericecal membranes. I never have been so bold as to contend that the discovery of these folds in the fetus alone explains the origin of the adult pericolic membrane, or of Lane's kink. These ideas are submitted as evidence and not as established and complete proof. I did present three somewhat original conceptions, however, which I think are worth remembering as we proceed further with the study of this subject. If I were asked to state as briefly as possible the causation of the pericecal membrane I should write down "the fetal folds

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plus x," and make the "x" quite large. We believe the fetal folds to be factors. When one sees repeatedly in the fetus the adhesions between the caput coli and the mural serosa before cecal torsion through the arc of 180 degrees has taken place, when one sees it at a later stage somewhat more developed and again at still a later stage as a broad band of serosa, one cannot resist the impression that the fold is drawn out from the mural serosa by the internal rolling of the cecum. Again, when one sees so frequently in the fetus Reid's membrane or fold passing from the terminal ileum down into the pelvis, connecting the terminal ileum with the genital gland. one cannot resist the impression that this genitomesenteric fold bears some relationship to the anomalous bands seen in the adult, to which Mr. Lane has given the name of ileopelvic bands. Another point concerns the so-called bloodless fold of Treves. It is my conception that this membrane fuses with the caput coli and that many surgeons have seen it in the adult as a thin membrane tightly fitting over the caput coli and embracing the appendix. This thin fold, from which the appendix is often shelled by surgeons, is the persisting bloodless fold of Treves. It is frequently found in the fetus and no doubt often persists and is dealt with as an affair of adhesions during operations for so-called appendicitis.

Dr. J. E. Summers, Omaha: If Dr. Royster will read a recent monograph by Gray and Anderson of Glasgow, he will find his operation nicely illustrated and described. I said in my paper that, if you did not find peritoneal membranes of the pericolic type in the upper, lower or middle quadrants of the right abdomen, you would find them on the left side. By making traction you will find the white line in every person. By pulling on the sigmoid and drawing it toward the median line of the body, you will often find this white line. Dr. Law's cases are few in number and apparently he does not do much surgery on children. If you will examine a child's abdomen you will find the membranous bands there as often as you will find them in the adult. The only trouble is that they do not produce symptoms and are therefore overlooked. They are put there for purposes of support and produce no symptoms unless they cause angulation. If you do not look for them you will not see them, but they are there nevertheless in a considerable percentage of cases.

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SOME FEATURES OF ROENTGENOGRAPHIC CHANGES IN PITUITARY DISEASES

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The studies of the function of the ductless glands enabled us to understand more fully many pathologic skeletal conditions until recently unexplainable. These conditions may reveal themselves either in disturbance of growth or in changes of configuration. In regard to the former we are familiar with the changes following disorders of the sexual organs, of the adrenal cortex and recently also of the pineal gland. Delayed skeletal development is exemplified in the well-known condition of hypothyroidism, a condition in which we find persistence or delayed closure of the epiphyseal lines and late appearance of the bone nuclei.

As illustrative of the changes in configuration the well-known condition of acromegaly affords us a good example. It is characterized by marked mandibular prognathism and enlargement of the hands and feet, accompanied by hypoplastic bony changes, especially to be noticed in the skull and here accompanied by enlargement of the sinuses. The pituitary body has for a long time been associated with these anomalies, and this early view has been confirmed by later investigation, although these studies have given us quite a different explanation for these relationships.

The great importance of roentgenoscopy in these conditions of pituitary disease is evident; for not only is the diagnosis often confirmed by the roentgenographic findings, but sometimes it is based primarily on them. Such an examination must be directed, first, toward

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the gland itself and its neighborhood, and secondly, toward the bony changes occurring in the skeleton in general as a result of the glandular disorder. The characteristic acromegalic findings are well known and will not be dwelt on in the following remarks, inasmuch as recent roentgenographic studies have not revealed any new features in the skeletal picture.

The changes in the cervicodorsal spine, previously described and recently referred to by some French authors, corresponding to the kyphosis so often observed in acromegalic conditions, are, however, interesting, although not generally known.

In view of the limited time at my disposal only two aspects of the roentgenographic studies of pituitary disease will be taken into consideration. First, the general changes in skeletal development heretofore referred to, and secondly, the changes in the skull and in the sella turcica, which are of great importance in relation to the differential diagnosis.

According to clinical experience the anterior lobe of the pituitary body seems to be the essential factor in the production of acromegalic manifestations which are believed to be the result of hyperfunction of this gland. No one has succeeded, however, in producing a similar condition experimentally by feeding or by transplantation. The manner in which this hyperfunction manifests itself does not seem to be dependent so much on the age of the individual as on the time of onset; that is, whether before or after the closure of the epiphyseal lines. If the latter have closed, acromegaly develops; if they are still open, simple gigantism without the specific acromegalic changes occurs. Numbers of instructive examples of such cases are to be found in the recent work of Cushing.[1] Of much interest also from the roentgenologic point of view are those cases in which at a comparatively early age the epiphyseal lines have closed and the subsequent hyperfunction of the hypophysis

1. Cushing, Harvey: The Pituitary Body and its Disorders, Philadelphia, J. B. Lippincott Company, 1912.

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has produced real acromegalic changes. On the other hand, cases are reported which show only increase in stature in older individuals due to abnormally long persistence of the epiphyseal lines; but one must bear in mind that the rôle played by the pituitary gland in producing different types of gigantism, the normal and pathologic, has not been entirely explained.

In the majority of examples of the reverse condition, hypopituitarism, recorded in the literature, we find mentioned a lack of growth and delayed closure of the epiphyseal lines and a comparatively juvenile configuration of the skeleton without inclination to growth in height, a point of differential diagnostic value as contrasted with conditions dependent on changes in the sexual organs which will be mentioned later. Aside from the delayed closure of the epiphyseal lines we find also a delayed appearance of the bone nuclei, a finding which is said to be characteristic especially for the conditions before referred to (Falta). These cases are often combined with tardy sexual development and adiposity. There are, however, cases of pure infantilism without marked trophic changes, in which enlargement of the sella turcica has sometimes been found corresponding to a pathologic condition of the pituitary gland, an example of which we find in Cushing's book.

This hypofunction may be due either to a primary change in the gland or to secondary injury from a lesion in its neighborhood; and it is especially in this regard, namely, whether the pituitary symptoms are due to changes in the gland itself or are secondary to a tumor of its neighborhood that roentgenoscopy may give valuable information.

Before I speak about this important point in differential diagnosis, I should like to mention some variations in the sella turcica which may normally occur; for it is well known that in normal conditions the sella may show a marked variation in size and shape. A measurement of 15 mm. anteroposterior and 10 mm. vertical diam-

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eter is considered to be the limit in size to which it may normally attain; but in considering the size of the sella it is necessary to take into account the condition of the other ductless glands, especially of the sexual organs, which are known to have a definite correlation with the pituitary gland. It is known that castration produces hyperplasia of the pituitary gland and secondary enlargement of the sella turcica (Tandler and Gross), as opposed to the findings in the so-called "eunuchoid type," in which no enlargement of the sella turcica has been observed, in spite of the many resemblances to the true eunuchs in their somatic appearance.

Concerning the female sexual organs, undoubted changes in the hypophysis during pregnancy have been observed and enlargement of the sella turcica on roentgenoscopy has also been reported; indeed, in older multiparous women we find rather often a comparatively large sella, a finding possibly due to ovarian insufficiency. One should be cautious in making a diagnosis of pituitary tumor in these persons in the absence of clinical tumor symptoms. It seems possible, however, that pituitary hyperplasia secondary to insufficiency of one of the remaining ductless glands could produce true acromegalic changes, as suggested by a case of acromegaly following castration in an adult woman (Goldstein).

Furthermore, the condition of the thyroid gland must be taken into consideration, for in many cases of myxedema enlargement of the sella turcica can be demonstrated roentgenologically.

The two commonest variations—the short and rather deep, and the long and rather flat types of sella—seem to be dependent in some way on the shape of the base of the skull (Schüller). The first type we find, as a rule, in brachycephalic persons, the second in those who are bradycephalic.

Another interesting correlation has been noted by Fitzgerald, who asserts that the size of the sella always

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corresponds to the length of the posterior portion of the base of the skull, but that it is in indirect proportion to the distance from its anterior wall to the ethmoidal spine. The size of the sphenoidal cells seems also to bear an important relation to the configuration of the sella turcica. Although we have as yet no certain knowledge concerning these things, we frequently find a small sella in association with a massive sphenoidal bone or with poorly developed sphenoidal cells, aside from the acromegalic cases in which the enlargement of the sinuses belongs to the characteristic syndrome.

The anatomic relations of the sella turcica are the more important because we cannot see the gland itself on the roentgenogram. In spite of the cases occasionally reported, it is important to know that the shadow of neither the normal nor the pathologically enlarged gland can be seen on the plate, except in the rare cases in which calcification has taken place, a condition more often found in the so-called *Hypophysengangge-schwülsten* (Erdheim) and roentgenologically described in a single instance by Algyogy. Recently I have observed three further cases in Dr. Cushing's clinic which seem to belong in the same group, a report of which will be given in greater detail at a later time.

In general, however, it may be said that conclusions in regard to disorders of the gland itself can be drawn only from the changes in the bony parts. These changes in the sella turcica are represented by its enlargement, by a thinning of the floor and by a thinning and absorption of more or less of the dorsum and of the posterior clinoid processes.

It is now interesting and of great importance to note, as it has been shown by Erdheim and Schüller that the order of appearance of these changes in the sella turcica is quite different in the case of a tumor of the pituitary gland itself—the so-called intrasellar tumor, on the one hand, and tumor of the hypophyseal stalk, or other pathologic condition, of the immediate neigh-

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borhood of the gland, on the other hand. In intrasellar tumors we find first an enlargement in the site of the sella, with increasing thinning of its floor and of the dorsum sellae, followed later by more or less pronounced absorption of the posterior clinoid processes and of the dorsum sellae. This thinning of the floor and of the dorsum may finally cause a disappearance of the normal border, so that after a time we may find on the roentgenogram only very faint lines—the remains of the dorsum sellae.

Quite different is the sequence of changes in the other types of tumor mentioned. Here the absorption of the clinoid processes and of the dorsum sellae is first noticed, and although later we find an enlargement of the sella, nevertheless this enlargement is rarely so pronounced as in the case of an intrasellar tumor; and the sella is always of the characteristic flat type, as compared with the deep and round sella of an intrasellar tumor. It is evident that in a later stage of development in these two types it would be difficult or quite impossible to make a differential diagnosis.

Furthermore, in tumors of the brain which have no topographic relation whatsoever to the pituitary gland and in the case of internal hydrocephalus, we find not infrequently changes due to the increase of intracranial pressure, and very similar to those heretofore mentioned in connection with extrasellar tumors. In these cases the differential diagnosis can be made only from the clinical symptoms and the other Roentgen-ray findings in the skull, for tumors of the hypophysis in their early stage only exceptionally show signs of increased intracranial pressure on the roentgenogram. Tumors of the brain, on the other hand, often produce even at this time an enlargement of the diploetic veins and deepening of the pacchionian grooves and of the furrows corresponding to the convolutions of the brain. The differential diagnosis can often be made by the secondary changes of the skull and by a lack of the typical

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acromegalic changes, such as a thickening of the bone, enlargement of the sinuses, mandibular prognathism, etc.

Especial attention should be called, according to Schüller, to the development of the so-called sphenoparietal sinus—a venous channel connecting the sinus cavernosus with the convexity of the skull. In big tumors of the sella this sinus is often enlarged, which can be explained by pressure of the growth on the sinus cavernosus. In normal persons, however, one must remember that a large sphenoparietal sinus is occasionally to be found; so that this condition must always be interpreted with a certain amount of caution.

In tumors of the acoustic nerve, a rather characteristic change in the dorsum sellae has been observed. These tumors sometimes produce not only a thinning of the dorsum sellae, as in other extrasellar growths, but also a rather characteristic tendency of the dorsum sellae to incline forward. This fact enables us at times to make a diagnosis of an acoustic tumor from the roentgenogram, especially when these changes of the sella are combined with the described enlargement of the meatus acusticus (Henschen).

All these examples show that changes of the sella turcica in size and shape occur rather frequently in conditions other than true pituitary tumors; that is, in tumors in the neighborhood of the sella turcica as well as in tumors without any topographic relationship to the hypophysis and in cases of increased intracranial pressure due to internal hydrocephalus. On the other hand, the great influence of the other ductless glands on the development of the pituitary gland and on the secondary changes of the sella turcica has been demonstrated. These facts prove that not every change in the sella turcica is necessarily to be interpreted as a result of a primary pituitary disease, a fact which I hope I have emphasized especially in these brief remarks.

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ABSTRACT OF DISCUSSION

DR. CHARLES H. FRAZIER, Philadelphia: There is still so much obscurity about lesions of the pituitary body that we should welcome anything that will throw additional light on them. In some cases the diagnosis is quite simple, and in others most difficult. To the latter group belonged a case in which I operated a few months ago. The patient had not a trace of the metabolic changes that have been attributed to pituitary disease, either of the hyperplastic or dystrophic type; nor were there any neighborhood symptoms. The only symptoms, and these had been present for a long time, were headache and optic atrophy; and the real nature of the lesion had not even been suspected by the many neurologists who had seen him until a roentgenogram revealed the typical enlargement of the sella turcica.

We must not lose sight of the fact, that of the many things to be learned as to the diagnosis of pituitary disorders, there are other processes which may cause alterations in the structure of the sella turcica; such, for example, as syphilis, tuberculosis and hydrocephalus. Furthermore, we must not forget that in certain cases, there may be no changes in the configuration of the sella at any time in the course of the disease, and in a great many more there are no changes at all in the earlier stages. Disturbances in the structure of the sella turcica are, therefore, among the late rather than the early symptoms and are at the best by no means constant. Whether or not operation should be postponed whenever the findings of the radiograph are negative, therefore, becomes a practical consideration. This was the situation in one of my recent operative cases. For five years there were symptoms more than suggestive of pituitary disease, and yet, because the roentgenograms showed no changes, an operation clearly indicated had been postponed. Rather than be unduly influenced by the negative findings of the Roentgen ray, surgeons should develop a technic so safe and satisfactory in every respect that they will be able to determine with the naked eye at an exploratory operation whether or not there is a lesion of the hypophysis.

Another question of practical importance as to the value of the roentgenogram is this: Can any information be derived from the latter as to the method of exposure to be adopted in any individual case? When the sella is deepened at the expense of the sphenoidal sinus, that case may be better approached by the transphenoidal route, but, except when the outlet to the sella is so narrow as to make it inaccessible from above, the transfrontal method of approach, in my belief, is the operation of choice. In the first place, we avoid meningitis, so common a complication in transphenoidal operations; in the second place, we are able to determine with greater precision whether we are dealing with an operable or an inoperable lesion. It is impossible by the transphenoidal route to

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determine how far the lesion extends beyond the confines of the sella; how much of the tumor is extrasellar and how much intrasellar. If one takes the trouble to investigate the necropsy records of cases in which operation has been done by the transphenoidal route, he will be surprised to see how often conditions found at necropsy do not conform at all with those described at the operation. The transfrontal route is a simple, safe and satisfactory method of reaching the sella, the cosmetic results are all that one could ask, and, what is of paramount importance, there have, in my series, been no fatalities.

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ROENTGENOSCOPY OF THE LIVER AND BILIARY PASSAGES WITH SPECIAL REFERENCE TO GALL-STONES

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It seems timely to emphasize the possibilities of soft tissue roentgenography in the recognition of diseases in the right upper quadrant of the abdomen. The purpose of this paper is to call attention to a number of facts concerning the biliary tract, and particularly the gall-bladder, obtainable with the aid of the Roentgen-ray. I wish to preface my remarks by insisting on the necessity of a careful history and a thorough physical and laboratory examination of the patient by the other older-established methods before a correct estimate can be placed on the roentgen findings.

The liver, being opaque to the Roentgen ray and surrounded by more or less transparent organs, permits a study of changes in its position, its size and its shape—often contributory evidence of considerable value. The outline of the upper border of the liver is easily determined. Roentgenographically speaking, the diaphragm is inseparable from the normal liver, their shadows being one, forming the so-called phrenohepatic shadow. The brightly illuminated pulmonary field presents a sharp contrast to the general gray dimness of the abdomen, permitting the upper border of the liver to be accurately studied. One may recognize even slight irregularities in its contour. In a number of cases, a nodular condition of the liver, later verified by operation or necropsy, was determined by a study of the phrenohepatic shadow.

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The shadow of the inferior surface of the liver, however, is not so easily determined, being confused with the image of a number of organs—the right kidney, the duodenum and the great vessels, and probably also the colon. In order to emphasize the inferior border of the liver shadow, distention of the colon or stomach or both by means of gas may be practiced. The colon is frequently found already distended by gas collections or it may be artificially distended through the rectal injection of air. Inflation of the stomach may be secured by giving first a solution of 4 gm. of sodium bicarbonate in a quarter of a glass of water, followed immediately by a slightly smaller amount of tartaric acid in an equal quantity of water. Except in special studies, it is rarely necessary to practice this maneuver. In the majority of roentgenograms of the bismuth-filled stomach and colon, the inferior border of the liver, at least its lower two-thirds, is distinctly outlined.

Screen or plate study, especially with the patient in the right lateral position, may give valuable information with reference to the size and shape of the liver, the presence of abnormal fissures and additional lobes, congenital anomalies in shape and position, torsion of the liver, the corset liver and the presence of the irregularities attending a syphilitic, malignant or cirrhotic disease of the liver (Figs. 1, 2, and 3). (In the corset liver, there is usually a distortion upward, as well as a vertical elongation of the organ, associated with compensating displacements of the small intestine, the colon and the stomach. A lateral study of the patient may reveal a transverse depression on the anterior surface of the right lobe of the liver due to the constant pressure of the corset.) These deformities cannot always be shown, but in the numerous cases in which they can be demonstrated, the evidence is of value.

Normally the diaphragm and the liver are inseparable. When the shadow of the diaphragm is separated from the liver by an area of clear or transparent tissue, the

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appearance is very suggestive of abscess. Occasionally a case may be encountered in which an abnormal position of the transverse colon gives rise to a change in the percussion note, which, together with the roentgenographic appearances, may lead to the diagnosis of hepatic abscess. Further investigation may show an abnormally long mesocolon, permitting unusual mobility of the colon so that it rises above the superior surface of the liver. This possibility was first described by Chilaiditti, who reported several cases.

Roentgenographic study of the liver is especially valuable in the location of abscess on the posterior or superior surface of the liver. Only in the most extraordinary cases is the Roentgen ray likely to give information concerning abscess in the lower portion of the liver, the abscess extending downward instead of upward toward the lung.

Among the appearances suggesting subphrenic abscess are the following: 1. Diaphragm movements limited and painful, with resulting immobilization of the liver. The other portion of the diaphragm, usually the left, varies its position as usual, or is perhaps more free, in a compensatory manner. 2. The contour of the upper surface of the diaphragm projects unusually high into the clear zone of the lungs. 3. Pulmonary involvement may be seen, the result of infection or rupture. 4. If gas is present in the abscess, the level of the fluid will be discernible beneath the diaphram, the surface of the fluid remaining horizontal regardless of the position of the patient.

I have had no experience with hydatid cysts of the liver. A number of cases are on record in which the diagnosis has been made by the Roentgen ray. Pioneer work in this line has been done in America.

In nodular carcinoma of the liver, relatively satisfactory results are obtained with the Roentgen ray. Roentgen study of the patient in an oblique, posterior position, may also determine the presence or absence of enlarged

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lymph-nodes of the mediastinum. Following the removal of a tumor of such a nature that the occurrence of metastases is feared, systematic roentgenoscopy may give accurate information as to the location of metastatic foci.

Occasionally a bismuth meal examination reveals a deformity of the lesser curvature of the stomach, when it is necessary to differentiate a lesser curvature tumor from pressure of the border of the enlarged liver. In such instances, determination of the presence or absence of peristaltic waves on the lesser curvature through fluoroscopy or serial roentgenography will permit the differentiation.

Béclère of Paris has described the orthodiagraphic examination of the liver, permitting exact measurements of its diameters. He states that measurements of this sort can be repeated at intervals and comparison made. As average figures, Béclère gives the extreme transverse diameter of the liver as 28 cm., anteroposterior diameter 17 cm., and vertical diameter 8 cm.

ROENTGENOGRAPHIC EVIDENCES OF GALL-STONES AND CHOLECYSTITIS

It has been generally understood for a number of years that it was scarcely worth while to submit a patient to Roentgen examination for gall-stones. This belief was founded on the fact that the principal constituent of gall-stones is cholesterin and that many gall-stones consist almost entirely of pure cholesterin. The experience of Carl Beck of New York only served to confirm this idea. Furthermore, the comparative infrequency with which gall-stones have been discovered in many thousand routine examinations of the urinary tract, as compared with the estimated frequency of gall-stones, according to necropsy statistics, has further served to discourage roentgenographic search for them.

Good authorities, such as Naunyn, have asserted that gall-stones are present in 10 per cent. of individuals. W. J. Mayo, in commenting on these statistics, calls

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attention to the fact that these high percentages have been obtained by post-mortem material from large hospitals, old ladies' homes, almshouses, etc., and that the illnesses or disabilities which brought these people to the hospitals were, in themselves, "sufficient to bring about gall-stones or to be caused by such disease." Mayo concludes that 0.5 per cent. would be a fair estimate of the frequency of gall-stones in persons of all ages; that 5 per cent. to 8 per cent. of women and 2 per cent. to 4 per cent. of men have gall-stones after the age of 50.

In my last thousand cases for examination of the gastro-intestinal tract following the bismuth meal, including a number of cases suspected of cholelithiasis, gall-stones have been identified, roentgenographically, in forty cases. In eight other cases, not examined with bismuth, roentgenograms of gall-stones have been obtained. The large number of gall-stone examinations in connection with the bismuth meal is accounted for by the fact that I do not recommend mere Roentgen examination of the gall-bladder region when searching for stones, but insist that the bismuth examination of the stomach, at least, and preferably of the stomach and bowel, should be included as a part of the Roentgen examination of the gall-bladder.

As before remarked, in a thousand patients referrred for gastro-intestinal disorders, I have demonstrated gall-stones by means of roentgenoscopy in almost 5 per cent. I believe I am safe in the opinion that, when gall-stones are present, they may be demonstrated by this means in 40 or 50 per cent. of cases. A negative opinion as to the presence of gall-stones following the Roentgen examination, of course, does not rule them out, but they are demonstrated with such great frequency that it is distinctly worth while to search for them in every suspected case. This is certainly a larger percentage of gall-stones relatively impermeable to the Roentgen ray than would be expected from our previous conception of the visibility of gall-stones. Pfahler's experience in the roentgeno-

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graphic search for gall-stones has been equally encouraging.

The increase in the number of cases in which gall-stones have been demonstrated by roentgenoscopy may be explained as follows:

1. Roentgenographic technic of to-day has made great advance, especially with reference to soft tissue detail. This is especially noticeable when intensifying screens are used, although in some instances, a clearer outline of gall-stones has been obtained on ordinary plates made without screen.

2. During a bismuth meal examination, the plate is usually anterior to the body and the tube behind, thus bringing the gall-stones nearer the plate on which their shadow is thrown and thereby increasing the probability of the shadow being recognized. On the other hand, during the usual examination for urinary stone, the plate is placed posteriorly, the tube being in front. In a number of instances it has been impossible to record a recognizable shadow of gall-stones on the plate made in a position for kidney examination, although on the plate placed anteriorly, the shadow was definitely seen.

3. One of the chief reasons for the more frequent discovery of gall-stones, roentgenographically, has been the fact that it has been considered distinctly worth while to look for them, and all plates of the hepatic region are most carefully scrutinized for any suspicious shadows.

4. Recent investigations have shown that it is rare to find stones composed of pure cholesterin on the one hand or of pure pigment salts on the other. The cholesterin stones "nearly always contain some pigment," most likely a calcium salt, and although nearly all gall-stones contain a good deal of cholesterin, calcium salts or bile pigments may be said to be almost invariably present. In the opinion of Dr. Williams,[1] calcium carbonate will

1. Williams, O. T.: Quoted by Dr. Thurston Holland; Arch. Roentg. Ray, March, 1913.

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be shown to be present much more frequently than has hitherto been thought. Dr. Williams concludes that "for a fuller understanding of the clinical aspect of gall-stones, the usually accepted classification of single cholesterin stones and multiple pigment stones needs considerable modification."

Suspicious shadows, when found, must be identified by various maneuvers to differentiate gall-stones from the various shadows with which they may be confused. Suspicious right upper quadrant shadows most likely to be confused with gall-stone shadows are those due to (1) calcareous deposits in the costal cartilages; (2) renal calculi; (3) calcareous deposits in a tuberculous kidney; (4) calcified mesenteric lymph-nodes.

Calcareous deposits in the costal arch are easily identified in stereoscopic plates as they are also easily recognizable in plates made postero-anteriorly.

Kidney stones may be identified by their clean-cut edges, their immobility, the homogeneous nature of the shadow and the fact that the shadow of the stone shows within the shadow of the kidney, although several plates may be made in different directions. A comparison of the exact size of the shadows made on two plates, one made anteroposteriorly and one made postero-anteriorly, shows that the shadow of the gall-stone is usually more clean-cut and distinct and somewhat smaller in the latter than in the former.

Pyelography is likely to be of special use in differentiating renal shadows. The shadow of the renal pelvis and the suspected shadow may coincide and several plates at varying angles should be made or else stereoroentgenograms secured, showing that the suspected shadow really rests an inch or more anterior to the renal pelvis shadow. Stereoscopic plates of the renal and gall-bladder region may alone suffice to identify shadows either biliary or renal. E. W. Caldwell was probably the first to apply the stereoscopic method to the identification and differentiation of suspicious shadows in the region of the kidney.

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Calcareous lymph-nodes are fairly common, but, as a rule, cast a very characteristic shadow, irregular, the edges being indistinctly outlined, with here and there areas of greater density, giving more or less of a mulberry appearance to the shadow. Calcareous lymph-nodes are frequently multiple and may be demonstrated to be perfectly freely movable by manipulation under the fluorescent screen, or by making plates with varying pressure applied in different ways on the abdomen.

Identification of hepatic or common duct stones by means of the Roentgen ray has been successfully accomplished by Beck and Pfahler, at least, and perhaps others. I have had one remarkable case of common duct stone successfully demonstrated roentgenographically (Fig. 14).

Many gall-bladder region shadows have characteristic markings which serve to identify them as gall-stones. In visible gall-stones, the calcareous deposits are arranged in strata, usually a calcareous deposit on the exterior, the center being less opaque. The stone thus may present a definite capsule-like circumference. Many gall-stones show facets; others are uniformly opaque. In stereoroentgenograms of the abdomen, the gall-bladder shadows are seen to lie in a plane considerably anterior to the position of the vertebrae and considerably anterior to the outline of the kidney itself. This conception may be further corrected and verified by stereoroentgenograms following the injection of collargol or a catheter into the pelvis of the kidney. It is also likely that stereoroentgenograms following the ingestion of a bismuth meal will show the relation of the suspected shadow to the pyloroduodenal shadow in a manner further serving to identify this shadow as gall-stone.

Under the fluorescent screen, one may often very satisfactorily study the relation of the suspicious shadow to a point of pain on pressure under the right costal arch. Of particular value is palpation following the bismuth meal, when one may find that there is definite localized

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pain on pressure at a point to the outer side of the duodenal shadow, moving up and down during respiration, whereas on accurate palpation on the gastric side of the duodenal bulb, no pain at all may be present.

Even if no suspicious shadows be present, a number of Roentgen ray findings following a bismuth meal are of assistance in the diagnosis of gall-bladder disease, with or without stone, namely:

1. Hepatofixation of the stomach, the pyloric region being drawn to the right and upward in a significant manner. Pfahler called attention to this sign two years ago. These adhesions rarely produce delayed emptying of the stomach.

2. A definitely tender spot of pain on pressure accurately localized to the outer side of the shadow of the duodenum. If the duodenal shadow is not sufficiently dense, it may be rendered so by the simple expedient of having the patient lie on the right side for a few moments, and then asking him to turn on the back while holding a full breath. The screen having been in readiness, the current is started, and fluoroscopic study made at once while the pyloroduodenal region is well seen. Or with the palpating hand or a wooden spoon, some of the contents of the stomach can be forced out through the pylorus into the duodenum. It is a characteristic of such cases that there is a lag in the emptying of the duodenum.

3. The presence of Riedel's lobe of the liver, when demonstrable following gas distention of the stomach and colon, is another contributory sign of gall-bladder disease. Particularly in cases of suspected gall-bladder disease, in which jaundice is not present this sign may be of special value. In several instances I have seen a rounded, localized enlargement on the inferior border of the liver, which proved to be an enlarged gall-bladder.

4. The hepatic flexure of the colon may occupy an unusually high position, a further suggestion of gall-bladder disease.

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5. The emptying time of the stomach following a bismuth test-meal is usually much shortened, and the outline of the duodenum is well seen owing to a delay in the emptying time of the duodenum or to a too rapid outpouring of the stomach contents through the duodenum. It was formerly supposed that this unusual visibility of the duodenum strongly suggested duodenal ulcer, but in my experience it may occur in any duodenal affection or in gall-bladder disease.

6. In a number of cases I have observed a spastic manifestation in the stomach, sometimes a spastic indrawing on the greater curvature high up near the cardia and at other times a complete spasm of the pylorus as an associated sign of gall-bladder disease. The same sign has also been seen in duodenal ulcer, tabes, hysteria, appendix disease and even in hyperthyroidism.

7. In a few cases, very abnormal disposition of the sigmoid flexure of the colon has led to a diagnosis of gall-bladder disease. The roentgenographic demonstration of aberrancies of the sigmoid colon has been discussed by Pfahler, myself, and various others. The sigmoid may be procolic or retrocolic. In one remarkable instance, the aberrant retrocecal loop measured 54 inches from the iliopelvic junction to the rectum and was adherent every inch of the way, including adhesions to the duodenum and the stone-filled gall-bladder.

TECHNIC

I have described[2] a technic for the routine Roentgen examination of the alimentary tract which is especially adapted to institutional work in which patients are easily subject to the call of the roentgenologist. Briefly stated, this technic is as follows:

At 6 a. m. the patient is given a meal consisting of 10 ounces of farina mush, 2 ounces of barium sulphate (especially prepared for Roentgen-ray work) and such flavoring materials as are suitable. The patient is

2. The full details of this method were described before the Chicago Medical Society, South Side Branch, Feb. 14, 1913.

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allowed to drink water and to pursue his usual program until the third hour, at which time he is first seen in the Roentgen-ray examining room.

Third Hour: As a preliminary to the gastro-intestinal study, the chest is first examined fluoroscopically, after which the tube is lowered and general note is made of the gray abdominal shadow with the barium-mixed food standing out in contrast here and there. The contour of the liver and spleen is frequently evident, even under the fluoroscopic screen. Gas collections may emphasize the outline of these organs, as well as delineate the course of the colon. The residue, if any, in the stomach is noted and studied as to size, shape, position, peristalsis and relation to points of pain on pressure. Suspicious shadows in the gall-bladder region are noted as well as the disposition of the bismuth in the intestine, and the patient is requested to return at the sixth hour.

At the sixth hour, the ileocecal region is the special point of study. Any residue in the stomach is distinctly pathologic and its cause may be further studied as the case indicates. Adhesions, redundancies, atypical disposition and tenderness of the terminal ileum are especially noted. If bismuth has passed into the cecum, it may be studied. The progress of the head of the bismuth column is carefully noted at every observation.

Tenth Hour: Any residue in the ileum is now likely to prove pathologic. The cecum is especially studied at this hour as to size, shape, position, mobility and tenderness. The appendix is likely to be filled and when filled one can study its position, its relation to points of tenderness, its fixity or mobility, and especially the question of constrictions of the lumen.

Special tables have been constructed by Hertz, Pfahler, Groedel and others, and have been confirmed by me in numerous observations, by which one may calculate the progress which the head of the barium column should have made at the different hours of observation.

Twenty-Eighth Hour: At or about the twenty-eighth hour, the patient returns for further observation, and

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special attention is paid to the contour, caliber, mobility, tenderness and position of the colon, which is frequently filled from cecum to ampulla at this observation. If the colon is not yet empty, the patient is seen once again at the thirty-sixth and fifty-second hour, and perhaps again at the seventy-sixth hour. Longer observation than this is hardly profitable. Any stasis at this hour is distinctly pathologic and enemas should be given to dislodge the stagnant barium-mixed bowel contents in preparation for the barium enema.

Barium Sulphate Clysma: The patient's large bowel having been thoroughly emptied by cleansing enemas, the barium clysma is injected. The patient lies on the back on the Haenisch or some other form of trochoscope. About 3 pints of barium suspension is placed in a container 2 or 2½ feet above the patient. The barium stream is allowed to flow by gravity until the pelvic and iliac colon are filled, after which the progress of the stream may be hastened by gentle pumping. The special purpose of the barium enema is to study narrowings which may be due to spasm-producing influences, to neoplasms, to extracolonic pressure, to adhesion bands or to kinks due to adhesions. By the practice of various manipulations, these questions are usually settled without difficulty. It is especially important to fill the cecum, at which time the competency or incompetency of the ileocecal valve to the barium enema may be noted. The patient is then allowed to evacuate the colon in the usual fashion. After a reasonable effort to evacuate the bowel, observation is then made to determine the degree of success.

Second Barium Sulphate Meal: The patient is now usually intelligent as to the objects of the examination and is cooperating most satisfactorily. He is now asked to return, fasting, preferably at 8:30 in the morning, no food or drink having been taken after midnight. First a barium-water test is made, after which a barium meal consisting of 2 ounces of barium sulphate in a pint of Oriental clotted milk is administered, the whole process

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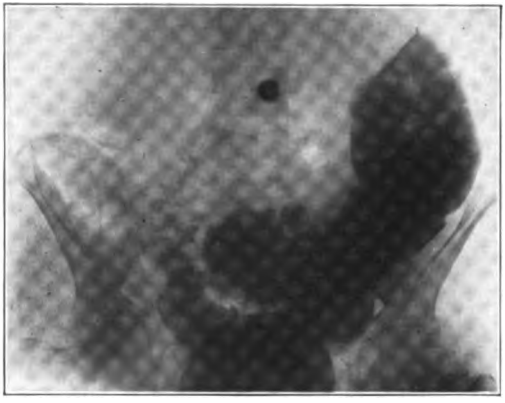

Fig. 1.—The colon is forced downward and to the left by an enormous carcinomatous liver, secondary to carcinoma of the stomach.

Fig. 2.—The outline of the carcinomatous liver can be distinctly seen, extending several inches below the crest of the ilium and pushing the stomach toward the left. The primary lesion was a small carcinoma at the cardia.

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Fig. 3.—Secondary carcinoma of the stomach. Six gall-stones present. Note the irregularity of the phrenohepatic shadow, contributing to the diagnosis of metastatic secondary carcinoma of the liver.

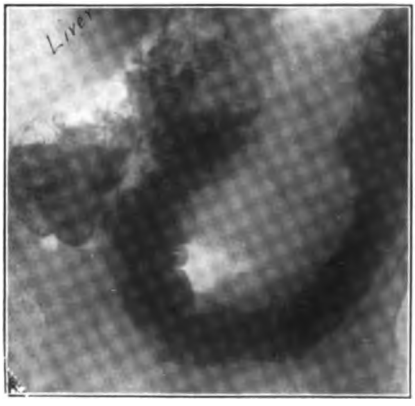

Fig. 4.—Bismuth and gas filled the colon, emphasizing the shadow of the lower border of the liver. Colon adhesions in the gall-bladder region.

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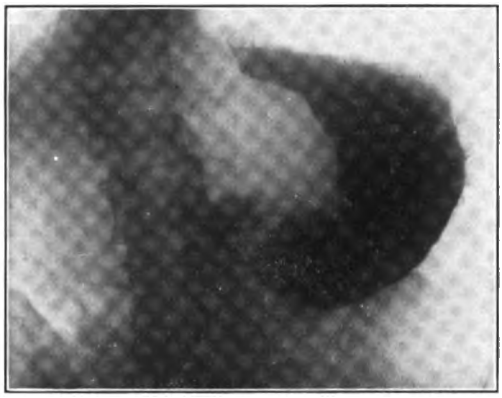

Fig. 5.—Lesser curvature of the stomach distorted by enlarged left lobe of the liver. On fluoroscopic examination peristaltic waves were distinctly seen, proving the tumor to be extraventricular.

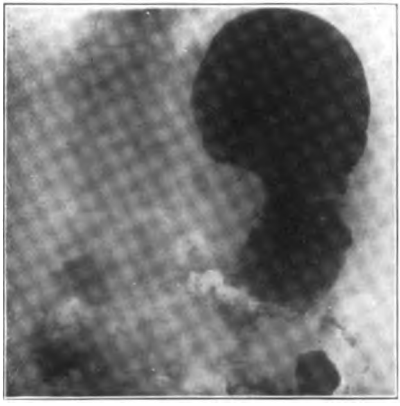

Fig. 6.—Lesser curvature of the stomach deformed by a carcinoma of the lesser curvature. Repeated plate and fluoroscopic examinations showed no peristaltic waves.

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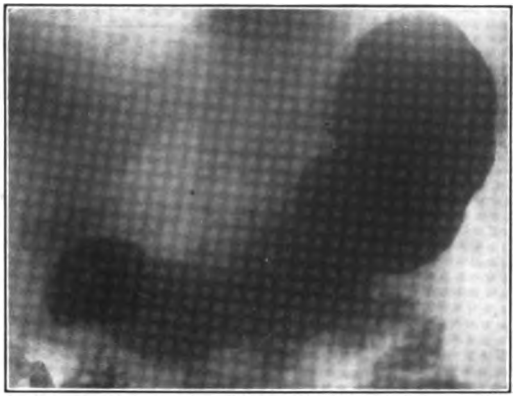

Fig. 7.—Hepatofixation of the stomach, the pylorus being drawn upward and to the right by adhesions due to gall-bladder disease. Two gall-stones present in this case.

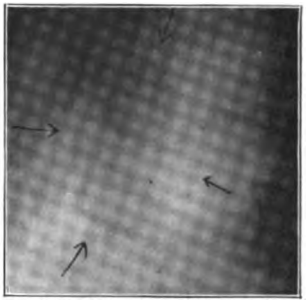

Fig. 8.—Four large gall-stones. Note the capsule-like shadow characteristic of certain gall-stones.

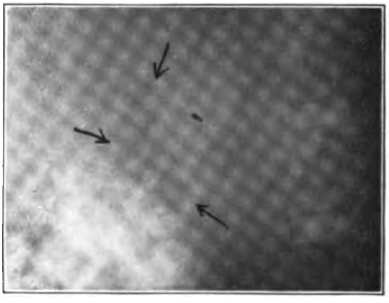

Fig. 9.—Thirteen gall-stones.

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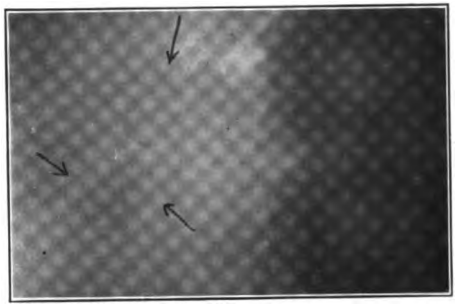

Fig. 10.—Six gall-stones.

Fig. 11 —Six gall-stones.

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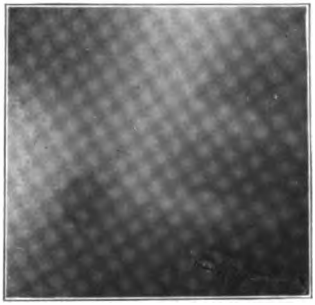

Fig. 12.—A single gall-stone.

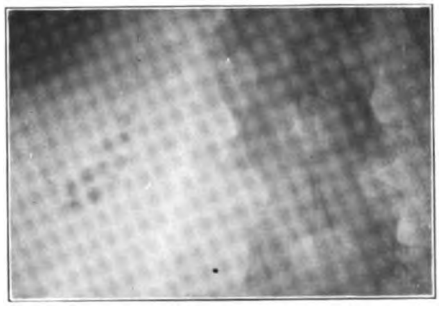

Fig. 13.—Ten gall-stones. This case illustrates the necessity of differentiating from renal calculi, for here the gall-stone shadows are superimposed on the well-defined shadow of the right kidney Roentgenograms made obliquely or stereoscopically are needed.

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Fig. 14.—More than seventy gall-stones. One in the common duct.

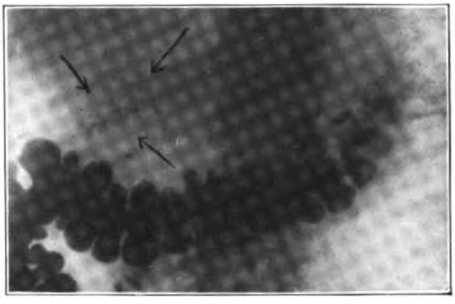

Fig. 15.—Twenty-seven gall-stones.

Fig. 16.—Multiple gall-stones.

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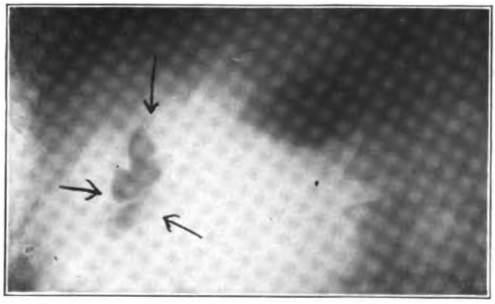

Fig. 17.—Multiple gall-stones.

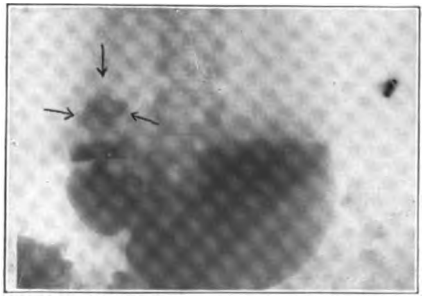

Fig. 18.—Multiple gall-stones.

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of taking food being watched on the screen. At this time the size, shape, position, character and efficiency of peristalsis are carefully studied and a review of the case is made.

During these various examinations, which have all been fluoroscopic, roentgenograms may have been made from time to time recording points of interest or for use in working out questions concerning which there is doubt. Special care is taken that at least one good roentgenogram has been made of the gall-bladder region and of both kidney regions. Serial roentgenograms are frequently useful, especially in heavy persons, in whom the fine detail of peristaltic behavior in the pyloroduodenal region cannot be studied satisfactorily by means of the screen. This examination is made in a routine manner, with slight modifications as may be indicated by the clinical factors in the case.

A routine examination of this sort is necessary for the alimentary tract for the same reason that in examination for urinary stone, the entire urinary tract of each patient should be studied. In a system of organs whose functions are so closely interrelated and interdependent as is the case with the digestive tract, one should hesitate to express an opinion about the behavior of any one part until after a thorough study of the entire alimentary system has been made. For instance, stasis in the cecum, patency and poor drainage of the appendix and insufficiency of the ileocecal valve is more readily appreciated in the presence of a spastic or organic obstruction in the distal colon.

During the routine bismuth examination which has just been described, the following are some points which may be noted with reference to the liver and gall-passages: (*a*) the contour and mobility of the right phrenohepatic shadow; (*b*) the delineation of the lower border of the liver and its relation to the iliac crest or other landmarks; (*c*) the presence or absence of suspicious shadows in the gall-bladder region which later may

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require differentiation between gall-stones and other confusing shadows; (*d*) the relation of the bismuth-filled stomach, particularly the pyloric end, to the hepatic shadow; and (*e*) the contour and mobility of the hepatic flexure of the colon.

SPECIAL GALL-BLADDER TECHNIC

Carl Beck[3] of New York probably exhibited the first roentgenogram of gall-stones in a living subject in October, 1899. In Carl Beck's position for gall-bladder roentgenography, the patient lies on the abdomen with three pillows underneath the clavicles, the elevation thus produced permitting extrusion of the gall-bladder, thus, theoretically, at least, bringing the calculi nearer the plate. The approximation is increased by turning the patient slightly to the right and raising the left side.

In the position recommended by Pfahler, the pillows are dispensed with, the patient lying prone on the abdomen, with the trunk sharply bent as far to the left as possible, to increase the distance between the right costal margin and the crest of the right ilium.

Béla-Alexander's method of plastic roentgenography ought to be of special value in the detection of gall-stones. I have had no experience with this method.

Soft (Benoist, 5 or 6), comparatively new tubes, intensifying-screens, instantaneous exposures and the use of an appropriate diaphragm with compression are all important factors in securing reliable roentgenograms. The patient must hold the breath absolutely. The examination should be conducted after careful bowel cleansing, preferably with the stomach empty. Stereoscopic plates, especially associated with the bismuth meal, are frequently of value in identifying suspicious shadows in the gall-bladder region.

During examinations of the roentgenograms, the source of illumination is of greatest importance. The intensity of the light should be easily regulated. Oblique illumi-

3. Beck, Carl: The Detection of Calculi in the Region of the Gall-Bladder, New York Med. Jour., January, 1900.

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nation may permit the detection of shadows which would otherwise escape the eye.

It is hoped that the foregoing observations may serve to emphasize the distinct value of the roentgenologic examination of the liver and the gall-bladder, always bearing in mind the importance of correlating the findings of the Roentgen ray with the evidence obtained by other clinical means.

ABSTRACT OF DISCUSSION

DR. LEWIS GREGORY COLE, New York: It is generally believed by the roentgenologist as well as by the profession at large that gall-stones do not show in the roentgenogram. The reason for this, I think, is largely, as Dr. Case stated, that we do not search for them as we should. I do not think that I could take exception to a single thing that Dr. Case said in his paper, except about the possibility of showing the sulci between the lobes of the liver. During the past six months I have found more gall-stones than kidney-stones, simply because I looked for them. They have to be differentiated. You cannot make a definite negative diagnosis, but you can make a definite positive diagnosis.

DR. GEORGE PFAHLER, Philadelphia: I believe that in 50 per cent. of these cases gall-stones can be demonstrated, and whether or not they throw a shadow depends on their composition. If they contain lime salts, they can be demonstrated. The kind Dr. Case showed were of that composition. In fact, gall-stones can practically all be demonstrated. Occasionally I can show a stone consisting almost entirely of pure cholesterin. A case of that kind was referred to me. The patient was passing blood in the urine and was extremely tender over the gall-bladder. In that case I found faint abnormal shadows near the common duct in two plates. I made a diagnosis of stone in the common duct and at the operation that diagnosis was confirmed. The stone was removed, and this shows that we can often go beyond the group to which Dr. Case referred. Such stones cannot be demonstrated by lantern-slides; but only by proper illumination and by one who is an expert in reading these negatives. They can also be demonstrated by a technic I described two years ago before the American Roentgen-Ray Society, namely, by bending the body strongly to the left. I wish to refer to a case in which such studies were most important to a patient suffering from severe pain in the right side for eight years. The appendix was removed, but the pains continued, and it was finally concluded that the pains were due simply to a desire to have morphin. A diagnosis of malingering was made.

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A careful study of the kidney showed no stone, but an examination of the gall-bladder region showed that the gall-bladder was filled with stones. Dr. Laplace removed 196 small, sharp-cornered stones. Every time one of these stones passed the patient had a severe colic. These are only a few examples in which the practical application of this method will often keep us from making a faulty diagnosis.

DR. A. D. BEVAN, Chicago: I have followed this subject rather closely for a number of years. In 1898, when the early work was being done with the Roentgen ray to determine the position of kidney-stones, we did some experimental work to find what evidence we could obtain in cases of gall-stone disease. Our results were interesting. We took a series of stones, no matter of what composition, and put them in a large beef liver. Then we made a roentgenogram to find what stones gave a shadow and what stones did not. As has been very well stated here this afternoon, the presence or absence of a shadow depends entirely on the composition of the stone. We found that the pure cholesterin stones did not show any shadow at all. The stones that contained carbonated calcium gave a good shadow. Some stones did not cast as much shadow as normal salt solution. In looking over this evidence we must ask ourselves as practical surgeons of how much value this work is. I think it is of comparatively little value. The time has not arrived when the Roentgen ray is of any great value in making a diagnosis of gall-stone disease. The men who are doing a great deal of roentgenographic work encounter many cases in which they find this evidence. They are not surgeons, and therefore they come to the conclusion that this would be of value in a given number of cases. To the surgeon, on the other hand, who is operating on hundreds of cases of gall-stone disease, this means of diagnosis would not be of much value. I do not believe that it would be a help in more than one case in ten. I want to emphasize that point. In one case, for instance, the evidence was very confusing. The clinical history was that of a typical common-duct case. The roentgenogram showed a definite stone in the position of the common duct. The operation showed that the stone was there. It was removed from the common duct. The conclusion was definite and absolute. You would hang a man on evidence of that kind. I placed that stone in some urine and found that it floated. It was a light stone. I took another picture of that patient and found the same shadow in the same place. It was a silent kidney-stone. I wish to emphasize the fact that the evidence given by the roentgenogram in determining the presence or absence of gall-stones is of very little value.

DR. J. T. CASE, Battle Creek, Mich.: In the part of the paper which I did not read I described Dr. Pfahler's technic to

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assist in the demonstration of gall-stones. Dr. Bevan's remarks are timely and should serve to repress youthful enthusiasm, but I should like to call your attention to a few facts. Among the last one thousand cases of bismuth-meal examinations made in my clinic for conditions such as gall-bladder disease, ulcer and carcinoma of the stomach, intestinal trouble, appendicitis and all kinds of abdominal conditions, I have demonstrated gall-stones in forty-eight. If only one-tenth of these cases can be diagnosed by the Roentgen ray, there were 480 cases of gall-stones among one thousand cases, and yet none of these cases were suspected clinically. I believe that the percentage—one in ten—is too high.

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ON THE MECHANICS OF PRODUCTION OF CERTAIN FRACTURES

GREENSTICK FRACTURES, BUCKLING FRACTURES, FLEXION AND TORSION FRACTURES

EMMET RIXFORD, M.D.
Professor of Surgery, Leland Stanford Junior University, Department of Medicine
SAN FRANCISCO

Much of the etiology of fractures, particularly from the teacher's point of view, may be presented as an application of the principles of practical mechanics—a part as it were of the subject of the strength of materials in engineering. With their characteristic thoroughness the Germans have given a good deal of attention to the mechanics of the etiology of fractures, particularly to flexion, torsion and perforation fractures, but American surgeons have been too much engrossed in the more practical problems of therapy to devote much attention to the somewhat abstruse mathematical considerations as to how the different forms of fracture happen to be produced, and the text-books used by our students have little to say on the subject.

In the multitudinous forms of accident causing fracture, the bones of the skeleton are subjected to stresses which in the ultimate analysis may be resolved into tensile and compressive stresses. These almost never occur singly but always in combination as in flexion, torsion and shearing stress. Their interrelations may be worked out mathematically and by experiment.

To these must be added shock or vibration, the effect of which in producing rapidly alternating molecular tension and compression is difficult to analyze and to esti-

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mate except in so far as shock is a determining factor in time. It is at least a sort of exciting cause, for when a bone is under bending or torsion stress almost to the breaking point, sudden shock or rapid and intense vibration will start the fracture, doubtless modifying its direction to some extent. In gunshot fractures, however, in

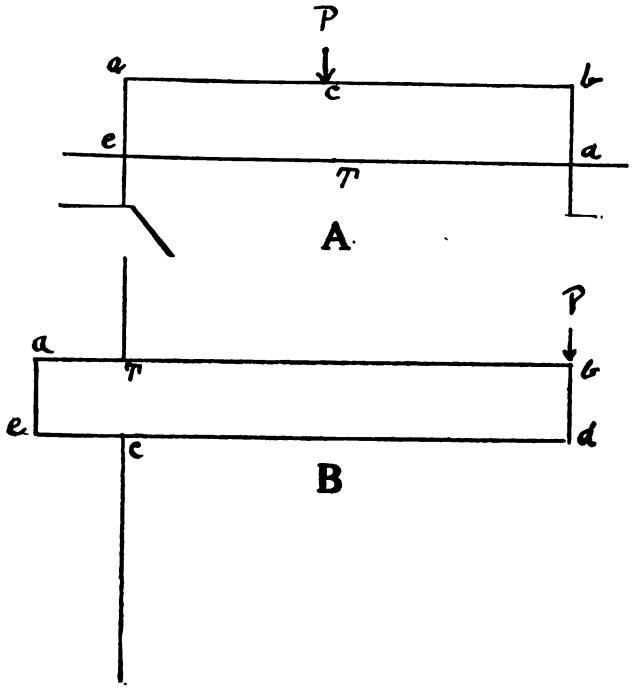

Fig. 1.—Diagrams illustrating *A*, compressive stress; *B*, tensile stress.

which the shock or vibration is intensified as a result of the velocity of the impact, this factor is of almost completely determining significance.[1]

Impact at low velocity simply tends to displace the bodies as wholes, which displacement, in the case of the long bones of the skeleton, resolves itself into bending or

1. Schumacher: Der Mechanismus der Lochfrakturen, Beitr. z. klin. Chir., 1909, lxiii, 81.

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torsion or both, while impact at high velocity in addition tends to produce local bruising or crushing; hence its penetrating power.

The simplest form of stress involved in the production of fracture is simple bending, illustrated in mechanics by the stresses in a beam supported at its two ends and carrying a load between the supports. Compressive stress is developed on the side of the application of the load—a maximum at the particular point of its application—while tensile stress is developed on the opposite side of the beam—a maximum at a point more or less directly opposite. When the load *P* (Fig. 1 *A*) is sufficient the beam will break, the fracture beginning at *T* or *C* according to the properties of the particular material. A cast-iron beam of uniform cross-section will begin to break at *T* where tensile stress is a maximum, while a similar wrought-iron beam will yield by buckling at *C*.

Quite similar are the conditions when a beam is rigidly fixed at one end and made to carry a load at the other. Tensile stress is a maximum at *T* (Fig. 1 *B*) and compressive at *C*.

The shafts of normal adult bones invariably break by yielding to tensile stress rather than to compressive, and in transverse fracture practically always break from simple bending strain as in Fig. 1 *A*, in fracture by direct violence, and as in Fig. 1 *B*, in fracture by indirect or transmitted violence.

The line of fracture is seldom exactly transverse even in a crystalline beam, for in the most rigid beam there is some bending which increases as the line of fracture progresses through the beam, and generally a point is reached at which the cohesion or resistance to the tensile stress in a transverse sense is equal to or less than that in the longitudinal, and the line of fracture takes a more or less oblique direction *a b* or *a c* or both (Fig. 2 *A*). In the latter case a loose fragment is separated off. Note that this loose fragment is on the side of the concavity.

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In rare cases in which the transverse cohesion is low compared to the longitudinal, simple bending may cause a longitudinal split in the shaft of the bone, the line of fracture at both ends running out on the side of the concavity—the piece broken off is squeezed out, as it were, on that side (Fig. 2 *B*).

While simple bending stress most frequently causes fracture more or less transverse, it may on occasion cause very oblique or longitudinal fractures not only as

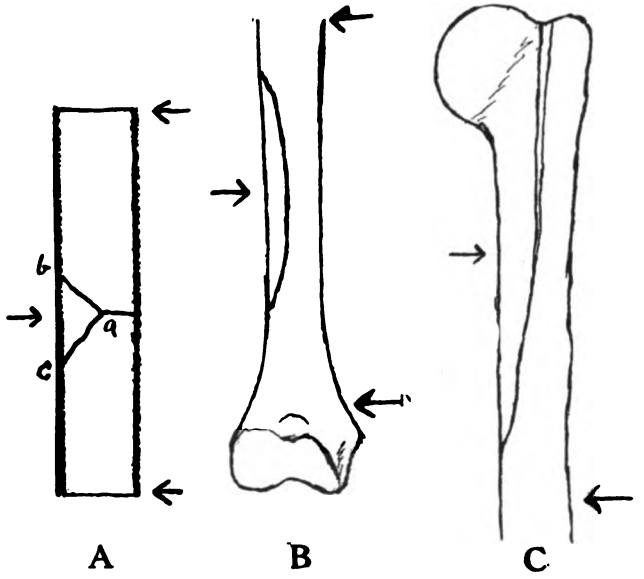

Fig. 2.—*A*, oblique fracture; *B*, longitudinal fracture; *C*, oblique fracture of humerus caused by leverage, in Astley Cooper method of reducing dislocation.

stated but also as in the case of the femur or the humerus in which the bone is bent inward over a fulcrum on the inner side. The fissure starts between the attachment of the capsule and the trochanter in the case of the femur and the tuberosities in the case of the humerus, and runs down the shaft, generally emerging on the inner side. Such a fracture I have seen which resulted from the use of the Astley Cooper method of reduction of a dislocated

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humerus, the operator's heel furnishing the fulcrum (Fig. 2 *C*).

In a structure in which there is a definite longitudinal grain as in tough wood subjected to severe bending strain the point *a* (Fig. 2 *A*) is reached before the line of fracture has extended far into the beam, and more or less extensive longitudinal fractures result with bending of the unbroken portions on the side of the concavity; that is, because of the resistance of the broken parts to further bending, they being released from longitudinal ten-

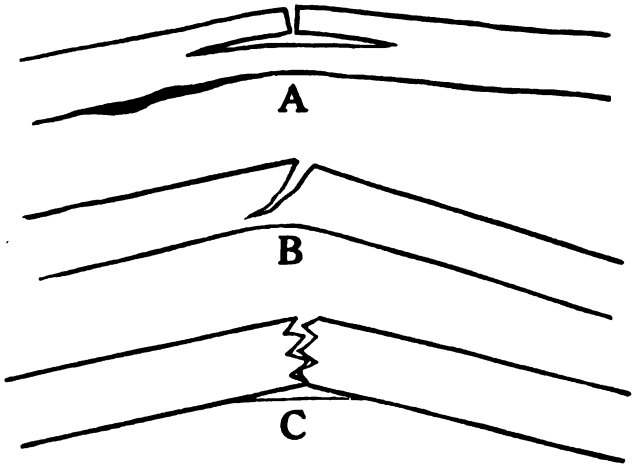

Fig. 3.—*A*, the usual conception of greenstick fracture; *B*, the usual finding in incomplete fracture in young adults; *C*, the usual finding in incomplete fracture of the shafts of bones in children.

sion at the point of fracture, transverse stensile tresses are developed even in advance of the line of fracture and longitudinal fracture results which is often multiple, as in the breaking of a hickory axe-handle (Fig. 3 *A*).

This is precisely the conception of the so-called greenstick fracture; but the lateral cohesion of the shafts of long bones is relatively so large that one would expect this mode of production of incomplete fracture to be rare in children. Yet most of our text-books set forth the greenstick fracture as typical of incomplete fracture in young bones, and of frequent occurrence.

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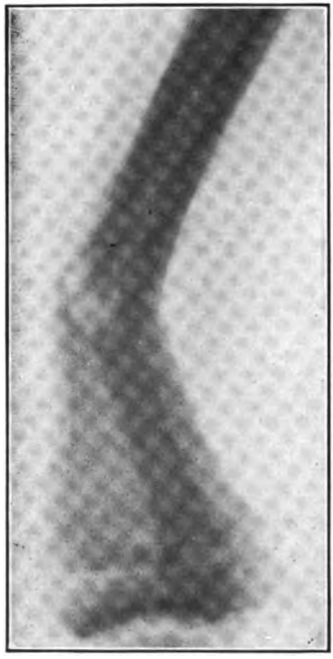

Fig. 4.—Bent fracture of radius and ulna in child of 12.

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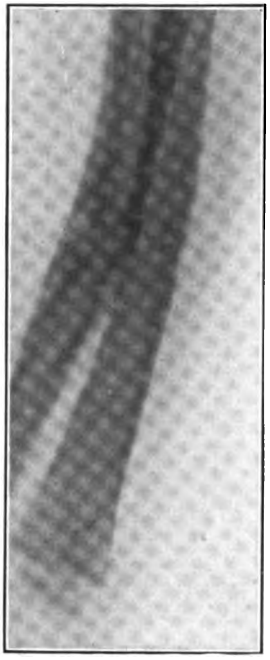

Fig. 5.—Bent fracture of shaft of ulna three weeks old and unreduced in child of 3, showing that fracture is complete. Note callus on side of the concavity.

Fig. 6.—Buckling fracture of radius in boy of 8, showing limits of compact bone of the shaft.

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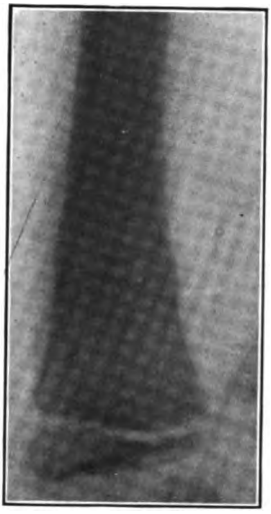

Fig. 7.—Same as Figure 11, dorsal view, showing lateral spreading of cancellous bone at point of buckling.

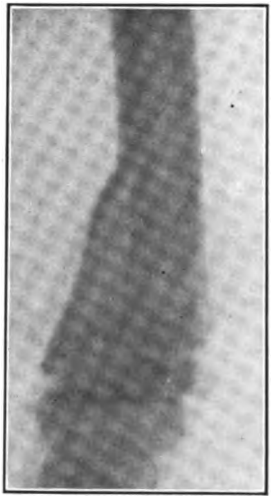

Fig. 8.—Buckling fracture with volar flexion in boy of 11

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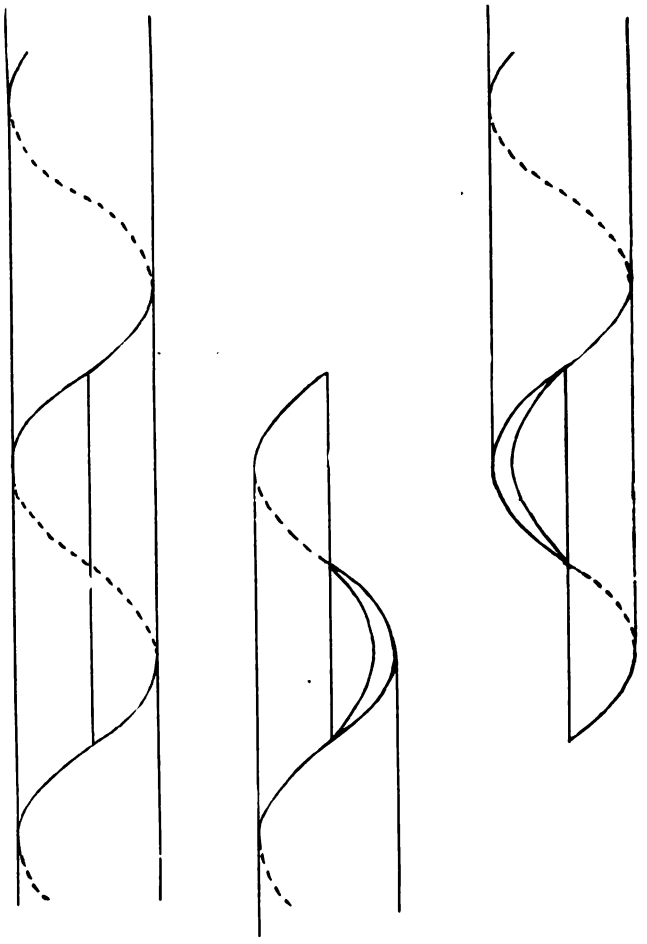

Fig. 9.—Type of spiral fracture before and after separation of fragments.

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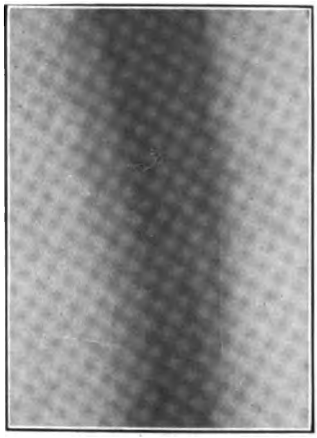

Fig. 10.—Spiral fracture in femur of child of 4, showing very steep spiral.

Fig. 11.—Right-handed spiral fracture of left femur.

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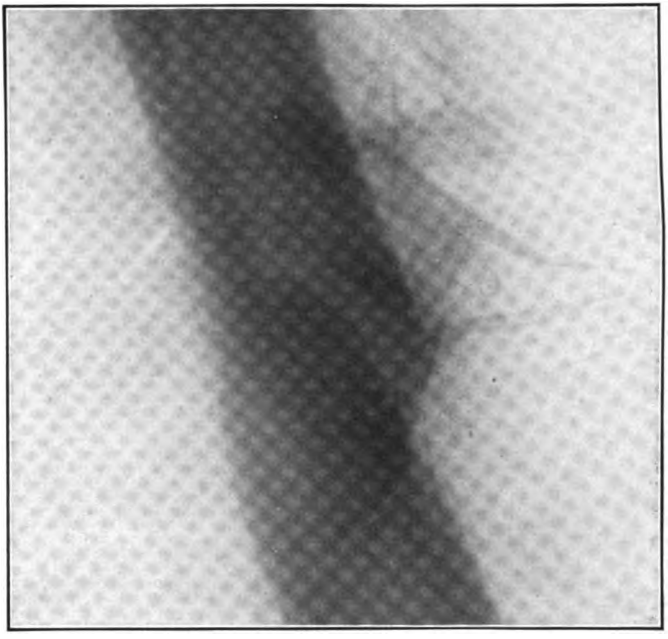

Fig. 12.—Left-handed spiral fracture of right humerus, from throwing a base ball.

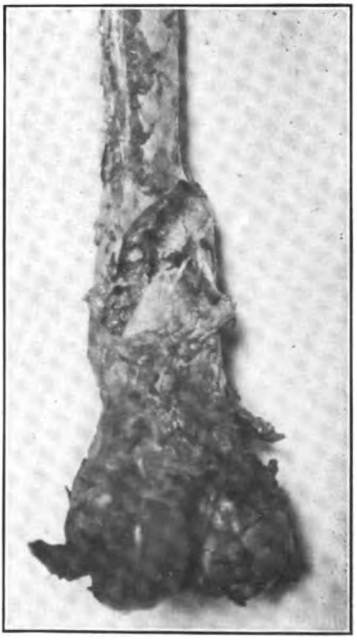

Fig. 13.—Experimental spiral fracture (right-handed) in right femur, periosteal hinge along longitudinal portion of fracture.

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Scudder defines a greenstick fracture as a partial break across the bone with bending at the seat of fracture.

Clinically it is true that fractures with bending occur frequently in children, but it is a question in how far they are of the type described and are properly designated greenstick fractures. My personal observation is to the effect that the true greenstick fracture according to the definition herein given, is the exception among the incomplete fractures in children, which are for the most part buckling fractures, that is fractures by compression, or are complete fractures with splintered ends but with only angular displacement. The only case of greenstick fracture proper which I have seen was in a man of 28, and was the type illustrated in Fig. 3 *B*.

Several factors come into play in producing the bent fractures in the long bones of children. The child's weight and strength (important elements in determining the amount of force active in causing many fractures) are small in proportion to the size of the bones in comparison with these relations in the adult. The bones are tough rather than brittle and are surrounded by a much more yielding investiture of periosteum and growing bone than are adult bones. Furthermore, the greater amount of fat in the child's arm protects the bone from shock.

Transverse fracture with lateral displacement does, however, occur in children if force enough is used, but often in incomplete fractures the force is expended as the tough bone yields and ceases when the bending reaches a certain point short of complete separation of the ends. Under such circumstances the enmeshed jagged splinters offer some resistance to lateral displacement and prevent rotation (Fig. 3 *C* and Fig. 4).

German teachers do not use the term "greenstick" fracture, but account for the bent fractures of children by the looseness and the toughness of the periosteal investiture which stretches and in these cases is supposed

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not to be torn completely across. Cotton[2] has come to the same conclusion in his paper on subperiosteal fractures in children (Fig. 3 *C*).

Roentgenoscopy in many so-called greenstick fractures in children after healing has advanced, even when no attempt has been made to reduce the fracture, will show callus on the side of the concavity as well as on the side of greater separation (Fig. 5). This would indicate either that the periosteum is ruptured or that it has been torn up, that bleeding has occurred beneath it and new bone has grown out into the clot.

While the distinction between the conception of greenstick fracture and complete fracture with jagged splinters and only angular deformity may be looked on as merely a quibble, it has this practical significance: It was common teaching to advise that the incomplete fractures in children be made complete in order to restore proper alignment, but some surgeons (Cotton) deprecate this advice on the ground that completing the fracture is unnecessary and increases the difficulty of maintenance of the correct position.

For the common form of incomplete fracture of the middle of the shaft of the child's bone, which as said before is really a complete fracture with only angular displacement, simply bending the bones back into place is efficient because there is nothing to break and the soft periosteum will stretch—unless so long a time has elapsed after fracture as to permit of a considerable degree of healing; but perfect reduction in the rare greenstick fracture is almost impossible without completing the fracture, for the reason that reduction requires a certain amount of stretching on the side of the concavity. Therefore, in my opinion, it is proper practice to complete the fracture in such cases by exaggerating the angular deformity present, taking care, however, not to go to the point of tearing apart the periosteum on the side of the concavity, for in general, espe-

2. Cotton: Boston Med. and Surg. Jour., Nov. 29, 1900, p. 553.

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cially in young bones, the less the periosteum is torn the less opportunity is afforded for the osteoblasts to grow out into the muscles, producing exuberant callus and interfering with subsequent function.

In the long bones of children the medullary canal is smaller than in adults and is especially undeveloped toward the ends. The compact bone of the shaft becomes thin much farther from the ends than in adult bones and the cancellous bone extends correspondingly farther from the epiphyses. In this region, in which incomplete fractures in children's bones are most common, for example, in the radius, the bone, like the wrought-iron beam, breaks by buckling on the side of the compressive stress (Figs. 6, 7 and 8).

Of American text-books on fractures, Hamilton, Stimson, Scudder and Cotton do not so much as mention fracture by buckling.

Of seventeen incomplete fractures of the radius and ulna in children of which we have roentgenograms in Lane Hospital, eight were typical buckling fractures occurring from 1 to 1½ inches above the lower epiphyseal line, half an inch or so below the upper epiphyseal line of the radius, and one was a fracture of the olecranon below its epiphyseal line. Of the eight near the lower end of the radius and ulna, six buckled on the dorsal surface and two on the volar (Fig. 8). The remaining seven were complete fractures with only angular displacement, some of them old enough after fracture and before attempts at reduction were made to show callus, which was quite as marked on the side of the concavity as on the side of the convexity. With the exception of one fracture of the ulna complicating one of the buckling fractures of the radius included above, within 1½ inches of the lower epiphysis, all of these complete fractures with bending were more than 2 inches above the lower epiphyseal line.

While the complete fractures with bending, if taken early, may be reduced by simple bending back into posi-

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tion, the fracture by buckling ordinarily cannot. But the buckling fracture should not be completed by increasing the flexion deformity present as is proper in the true greenstick fracture, but in forcing the bones back into correct position (slight overcorrection is desirable) the bone breaks, beginning at the buckled portion. There is no necessity, however, of so far overcorrecting as to tear the periosteum on the side of the former convexity.

Epiphyseal separation in children as in adults is apparently always the result of tensile stress, the epiphyses being pulled off.

The short bones and epiphyses of young children are almost never broken because of the large amount of cartilage they contain; in adults these bones break by yielding either to compressive or to tensile stress about equally, but, in the matter of relative frequency, individual bones differ from one another. For example, the patella, the olecranon and the lower epiphysis of the humerus are not infrequently broken by being pulled apart, but all three are almost as frequently crushed by direct blows. The os calcis when broken is generally crushed, as is the astragalus and the carpal semilunar.

Shearing stress gives few examples of fracture, yet in the cleavage fracture of the neck of the astragalus, the result of exaggerated flexion at the ankle, the sharp anterior edge of the articular surface of the tibia fairly cuts the head off the astragalus. The body of the bone is crushed and generally pushed out behind the inner malleolus (compare the cherry-stone theory of dislocation of the short bones). The common fracture of the carpal scaphoid may be looked on as of the same sort, but it more probably is a flexion fracture, the styloid of the radius being the fulcrum. From a severe blow on the flexed elbow in line with the shaft of the humerus the olecranon may cleave the humeral condyles apart, or the trochlea may cleave apart the upper end of the ulna.

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Of recent years a great deal of interest has centered in the so-called torsion or spiral fractures which we are beginning to realize are far more common than at first supposed. They were formerly classed with oblique fractures, but as the etiology of spiral fractures is better understood and the examples of both are studied, the class of oblique fractures is becoming smaller till it is largely merged in that of spiral fractures.

The long bones are frequently subjected to severe axial torsion, particularly the bones of the lower extremity and the humerus, resulting in typical forms of fracture which are of fascinating interest mechanically and therapeutically.

If a cylinder of approximately uniform constitution be subjected to axial torsion till it breaks, it is found that fracture has occurred in the form of a spiral, the direction of which is invariably the same as the direction of the torsion; that is, if the torsion be to the right (clockwise) the spiral will be a right-handed spiral like an ordinary screw-thread; and, vice versa, if the torsion be to the left the spiral will be left-handed. The fracture is completed by a more or less longitudinal fracture connecting two limbs of the spiral. This may be simply illustrated by twisting axially an ordinary chalk crayon till it breaks.

My attention was first called to the fact that a right-handed twist always produced a right-handed spiral fracture and a left-handed twist always a left-handed spiral by Theodor Kocher in 1899, and later by Dr. Monks of Boston, who made a series of experiments to determine the matter. The mechanics of the production of the spiral was put into graphic or mathematical form by Zuppinger.[3]

Axial torsion develops tensile stress throughout the surface of a cylinder balanced by compressive stress in its interior. When the bone yields to the tensile stress

3. Zuppinger: Beitr. z. klin. Chir., 1906, lii, 301, and 1909, lxii, 562.

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the fissure is propagated along and around the shaft for a long distance in spiral form, and the spiral may encircle the bone two or more times, the bone opening out like a curled shaving from a carpenter's plane. As soon as spiral fracture has occurred, further torsion or unrolling instantly shifts the tensile stresses to the inner surface in a hollow cylinder and the compressive stress to the center. If continued, therefore, the torsion causes longitudinal fracture connecting two of the limbs of the spiral and thereby completing the separation of the two ends of the bone.

In spiral fractures we generally find the spiral running some distance beyond both ends of the fragments (Fig. 9). We also find the periosteum forming a hinge along the longitudinal portion of the fracture in those cases in which there has been no considerable longitudinal force producing shortening; but even in this event the periosteum, though stripped up, is often intact on the side of the vertical part of the fracture, while it is generally completely torn along the spiral part.

Theoretically, under torsion stress the entire surface of the shaft of a bone being under tensile stress in parallel spirals, the bone might be expected to break occasionally in two or more parallel spirals. That it ordinarily breaks in but a single long spiral is determined by some weakest point in which the fissure starts, and this is apt to be single. However, it is not at all impossible that search through a large collection of fractured bones might reveal instances of multiple spiral fractures.

Loose fragments which are common in such fractures may sometimes be accounted for by multiple longitudinal fractures, but more often additional bending forces break off one or the other of the long tongues of bone between the spiral and the vertical parts of the fracture.

In actual clinical experience spiral fractures are seldom due to pure torsion, especially in the lower extremities. Weight bearing and sudden muscular effort to escape furnish a severe longitudinal force which, continu-

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ing to act after fracture, not only cause the stripping up of the periosteum and furnish the bending stress which breaks off the points of bone or drives them through the muscles and even the skin, but also may be conceived to play some rôle in the production of the fracture in the very beginning, adding a component of longitudinal shearing stress which would have the effect of increasing the pitch of the spiral. Pure spiral fractures are apt to be of higher pitch in young bones than in old, in small bones than in large (Fig. 10).

The vastly greater frequency of left-handed spiral fractures in the right lower extremity and of right-handed spirals in the left lower extremity has been tentatively accounted for on the basis of a spiral grain in the bones resulting from the internal rotation of the lower extremities in the process of development, to which Fleming called attention. In case this internal rotation is inhibited, as in the *sympous* or siren deformity, the toes invariably point backward. It is obvious enough that as between the upper and lower extremities the latter extremity has a relative rotation of 180 degrees internally, the flexor surfaces being behind instead of in front.

It would require exhaustive experiment to measure the relative resistance of living bones to internal and external rotation, but it would seem that the before-mentioned frequency of left-handed spiral fractures in the right lower extremity, and vice versa, might be efficiently accounted for by the greater frequency of exposure of the legs to external rotation. Most of such spiral fractures occur as the result of twists of the body, the foot being fixed. Since the foot projects forward or forward and outward it is more exposed to external rotation than to internal, for the other leg is in the way of internal rotation. Furthermore, left-handed spiral fractures are relatively quite as common in the right upper extremity which has not undergone the 180 degrees of internal rotation.

Fig. 11 is a roentgenogram of a right-handed spiral fracture of the left femur caused by muscular action on

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the occasion of the receipt of a bullet in the external condyle of the femur, and Figure 12 is a roentgenogram of a left-handed spiral fracture of the right humerus resulting from throwing a baseball. The spiral went more than twice around the bone. The fracture in the latter case being a pure torsion fracture had no longitudinal displacement, but operative reposition was required because of the entrance of a mass of muscle between the fragments. In another case a burglar running through a sand lot was shot in the right leg. The foot being fixed in the sand inhibited internal rotation as the man jumped and a left-handed spiral fracture resulted.

The right femur may be broken in a right-handed spiral by a right-handed twist as is shown in Figure 13, the result of an experiment on the dead bone with periosteum intact. The periosteum is torn almost the whole length of the spiral but makes a hinge along the vertical part of the fracture, which in this case was on the side opposite the linea aspera.

In the upper extremity the projection forward of the flexed forearm, which is the lever producing most of the spiral fractures of the humerus, effectually prevents internal rotation to the point of fracture by striking the body except when the arm is raised far from the side.

Torsion fracture of the fibula is less common than of the tibia, for often in torsion fracture of the tibia the weight of the body being borne by the fibula off center produces a flexion fracture; still if pure torsion be continued after the tibia has broken, spiral fracture of the fibula will be produced. Spiral fracture of the fibula does not occur without fracture of the tibia except of the external malleolus, which is not infrequently broken in a right-handed spiral on the left leg and left-handed spiral on the right leg, the force being an external rotation of the foot.

Fractures of the vault of the skull when made by blunt objects at low velocity are ordinarily flexion frac-

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tures, the break occurring in the inner or vitreous table as a result of tensile stress and at a point opposite the point of application of the force. The plane of the fracture is ordinarily oblique because of the transverse shearing stress. When the force is sufficient the tougher external table is bent inward to such an extent as to yield to the tensile forces developed in a more or less complete circle around the point of application of the force as a center, the fragments having slid past each other in the center and being permanently depressed. When the velocity is greater, one or more of the fissures produced may run long distances around the vault of the skull or into the base.

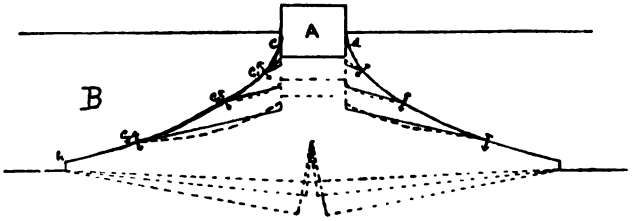

Fig. 14.—Note the stresses developed in perforating fractures (after Schumacher).

In young infants, however, the bone may buckle and spring inward like the bottom of a tin pan because the outer parts of the bone yield to the compressive forces developed. One finds the center of the depressed bone wrinkled.

The mechanics of perforating fractures have been well worked out by Schumacher[4] (Fig. 14), who shows that the form of fracture depends largely on the brittleness of the bone, that the wound of exit from the bone is smaller in compressible substances like plaster and cancellous bone than it is in brittle substances like glass and the inner table of the adult skull or the compact bone of the shafts of long bones. Of course, Teevan of Dublin long ago showed on the basis of actual experiment that the wound of exit in the skull was larger than the wound

4. Schumacher: Beitr. z. klin. Chir., 1909, lxiii.

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of entrance whether the ball was fired into the convex surface of the bone or into the concave surface of the opened skull, disproving the older idea that the greater fragility of the inner table accounted for the larger size of the wound within the skull.

I would close with a plea that in presenting the subject of fractures to a class of students the matter be looked on in the beginning from the point of view of mechanics. Experimental study should be given to the manner of breaking of plaster, clay, wood, old rubber, dead human bone and, since living bone breaks differently from dead bone, bone freshly removed from recently killed laboratory animals.

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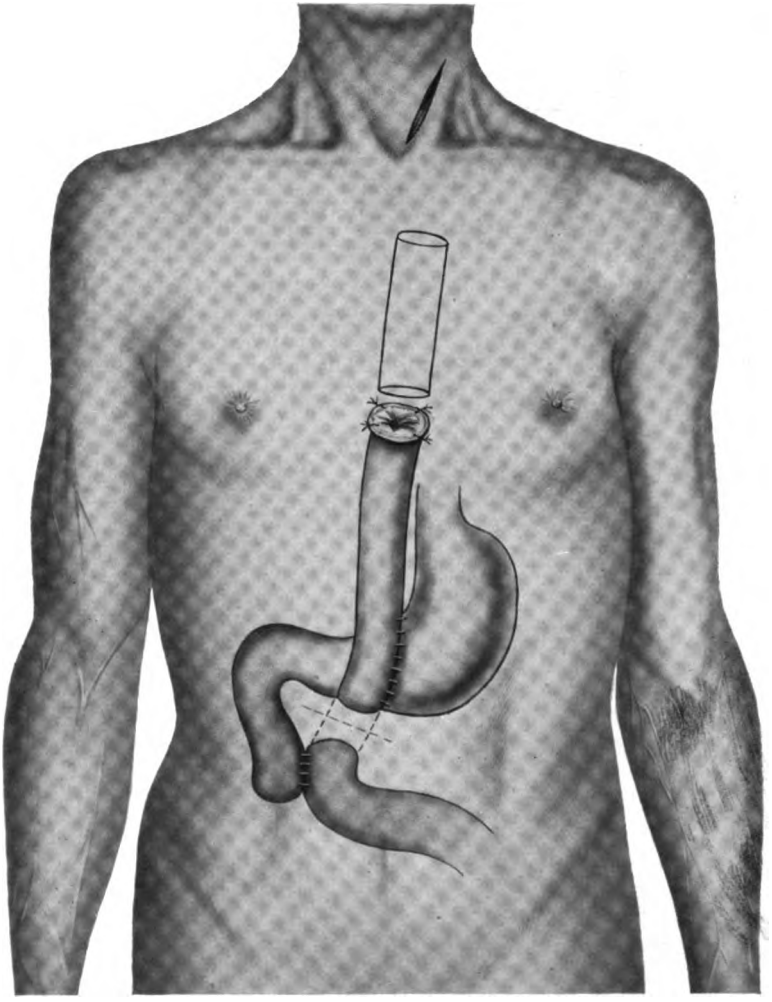

Fig. 1.—Diagrammatic, after illustration in Frangenheim's "Oesophagoplastik." L. c. Inferior esophagoplasty with the help of a totally excluded coil of the upper jejunum placed subcutaneously in front of the thorax (Wullstein-Roux operation). A lateral anastomosis unites the jejunal ends; the lower opening of the transposed coil has been joined to the stomach; the upper, which reaches up to the level of the mamilla, is anastomosed by a skin plasty with the neck of the esophagus.

ILLUSTRATING ARTICLE BY DR. WILLY MEYER

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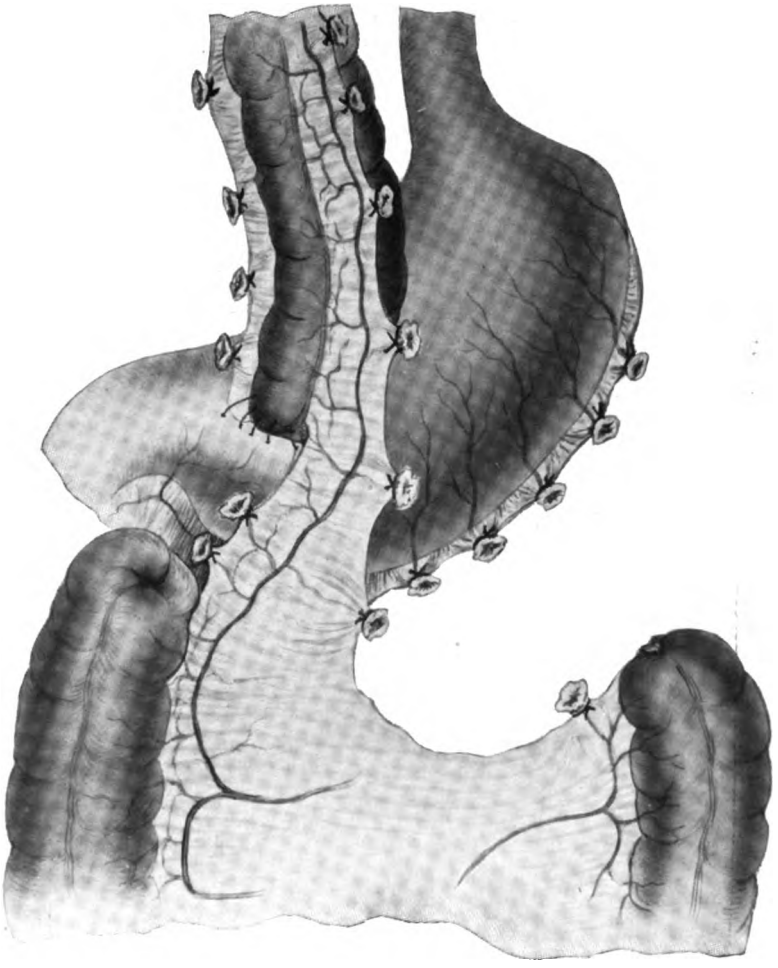

Fig. 2.—Inferior esophagoplasty with the help of the totally excluded transverse colon (Kelling-Vulliet operation). Note the excellent blood-supply of the transposed portion by the art. coli.

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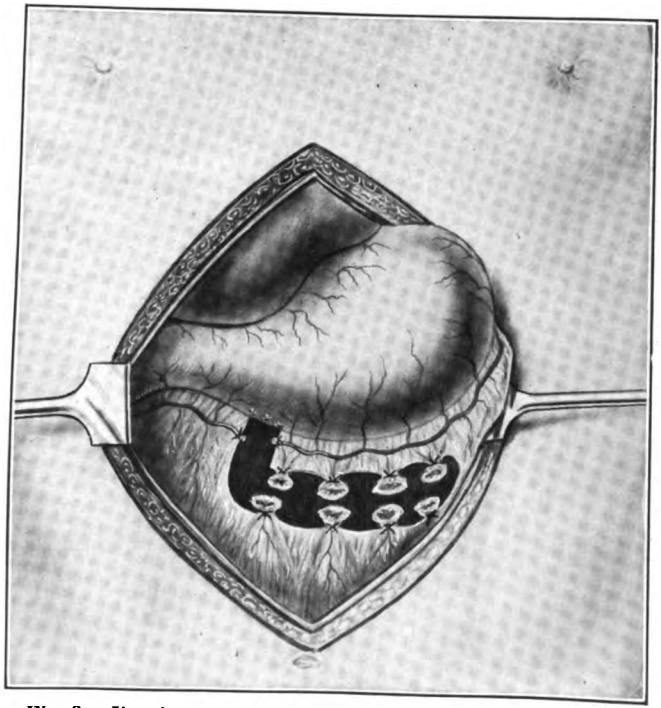

Fig. 3.—Jianu's gastrostomy and inferior esophagoplasty. Median incision; double ligation and division of omentum majus up to the point at which left inferior epiploic artery turns onto the stomach. Double ligation and division of right inferior epiploic artery; exposure of major curvature of stomach.

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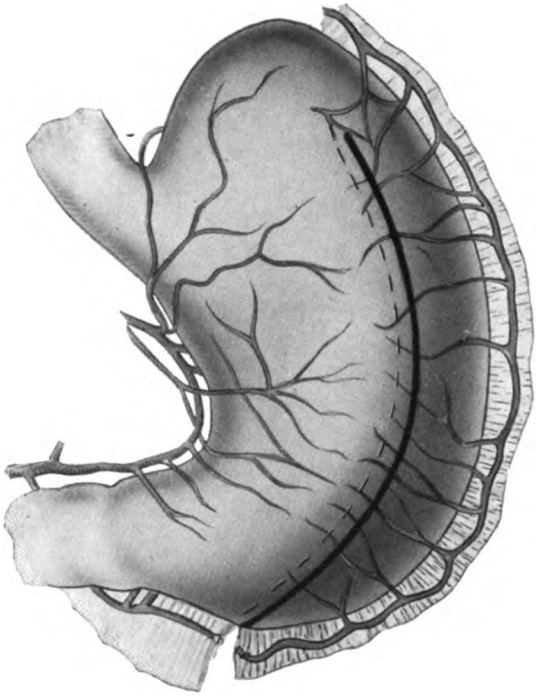

Fig. 4.—A mattress suture (dotted line) divides the lower one-third of the stomach with its major curvature from upper two-thirds; scissors then cut the stomach along the heavy line.

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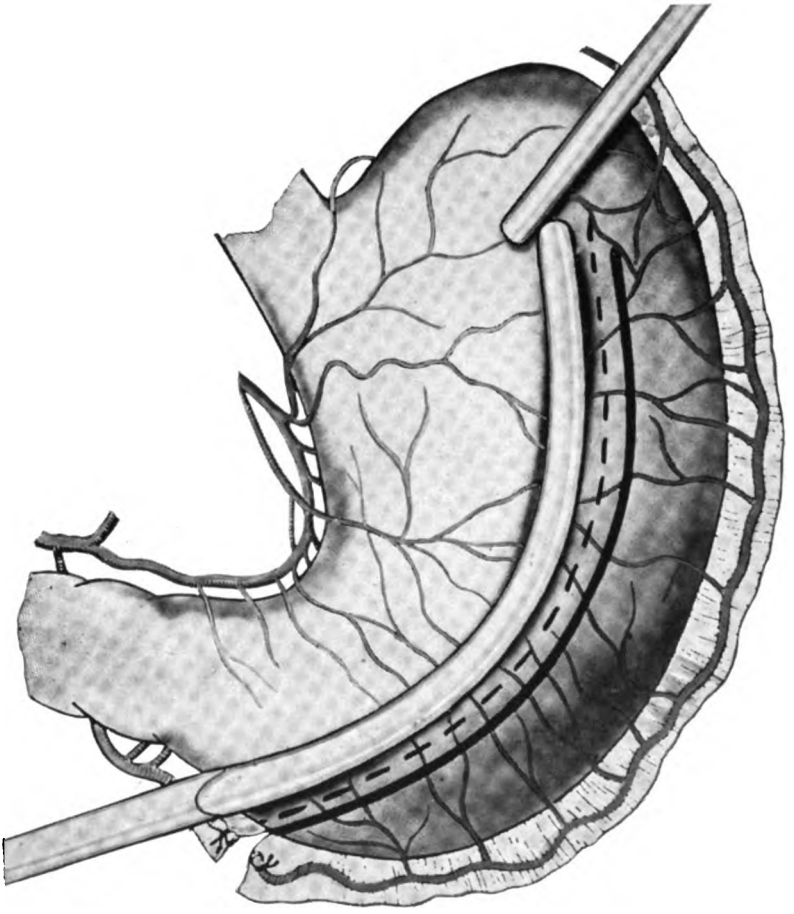

Fig. 5.—By placing a clamp (or clamps) with a curve corresponding to the line of the major curvature this part of the work can be simplified and rendered more aseptic.

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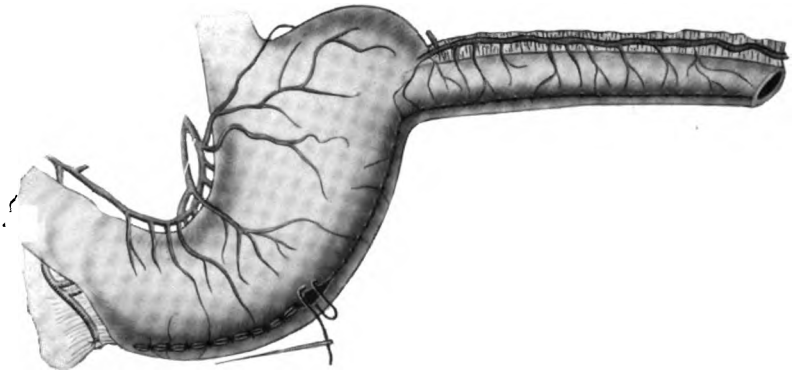

Fig. 6.—The major curvature flap formed into a tube—Jianu tube—by means of a continuous Connell suture; a second running suture (preferably Cushing's) secures the first row.

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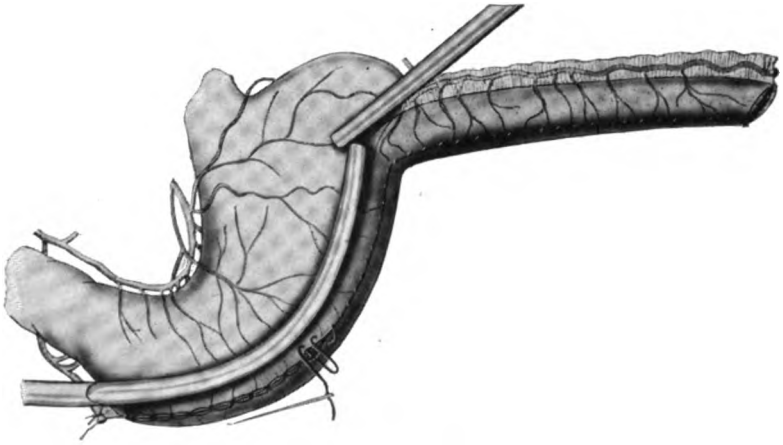

Fig. 7.—The same as Fig. 6, with clamps in place.

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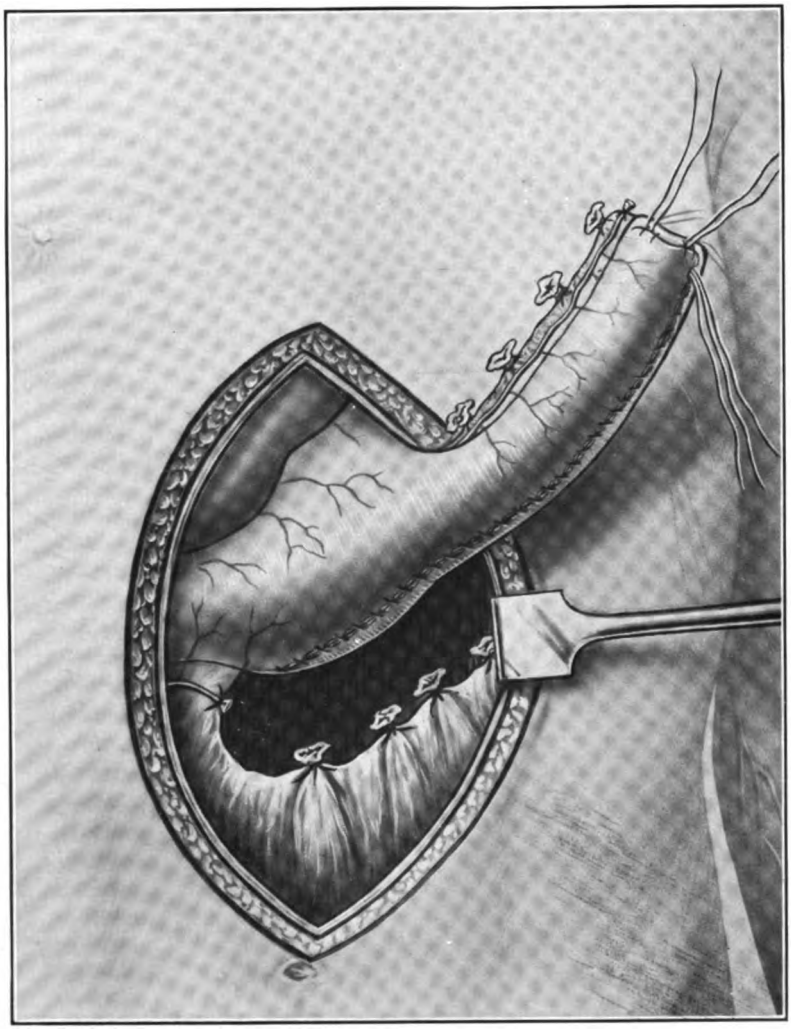

Fig. 8.—Jianu's tube turned outward and upward, showing ligated major omentum with blood-vessel supply; end of tube inverted and temporarily closed by two sutures, their ends left long; the three ends of the Cushing suture are also left long.

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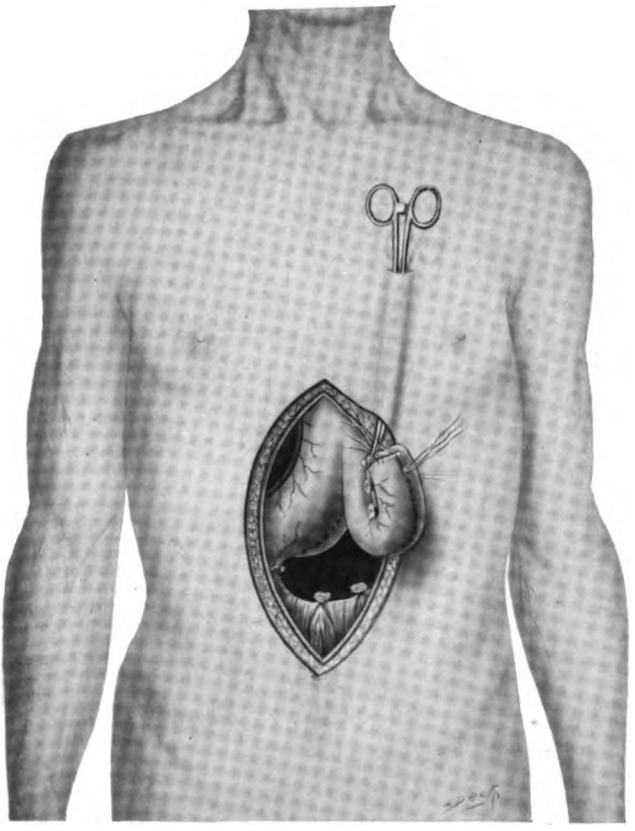

Fig. 9.—Stomach turned so that base of tube at fundus is flush with upper angle of abdominal incision; short transverse incision over third left costal cartilage, or above the same, according to length of tube; long curved dressing forceps there introduced under skin meets left forefinger of surgeon pushed upward from upper angle of abdominal wound; a wide subcutaneous wound is made. Forceps passed under bridge catches the sutures left long of inverted upper end of tube (in the illustration the subcutaneous canal is shown very narrow by mistake; the forceps should catch the ends of all three sutures instead of only two).

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Fig. 10.—Tube pulled through, inverted sutures removed, tip cut transversely and mucous membrane stitched all around to skin; a short strip of gauze introduced at either side of tube for drainage; abdominal wound closed.

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Fig. 11.—First patient operated on according to Jianu with needle and thread, Dec. 26, 1912. Tube placed underneath pectoral muscles; upper end stitched to skin with through and through sutures,—mistake—; produced localized gangrene of sero-muscular coat with circumscribed fat-phlegmon and perichondritis, causing retarded convalescence (c. f.).

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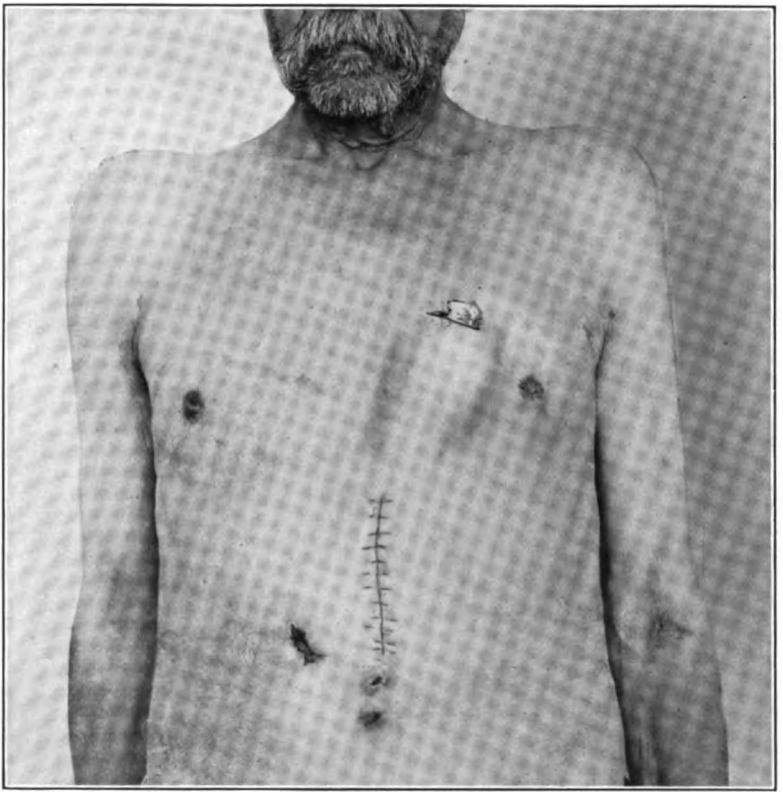

Fig. 12.—Second patient with Jianu's operation (February, 1913). Venous anesthesia with ether, followed by a severe bronchopneumonia; Hüfti's wire-stitching instrument is used. Tube placed subcutaneously, only mucosa stitched to skin at upper opening, which is over third costal cartilage; primary union. Base of tube stitched by two sutures to parietal peritoneum at upper angle of abdominal wound in such a way that an angulation of the tube is formed at this place on account of the sinking backward of the stomach into the abdomen. There is very little leakage of stomach contents from the start; a plug of gauze, closing the opening of the Jianu tube, keeps the patient dry.

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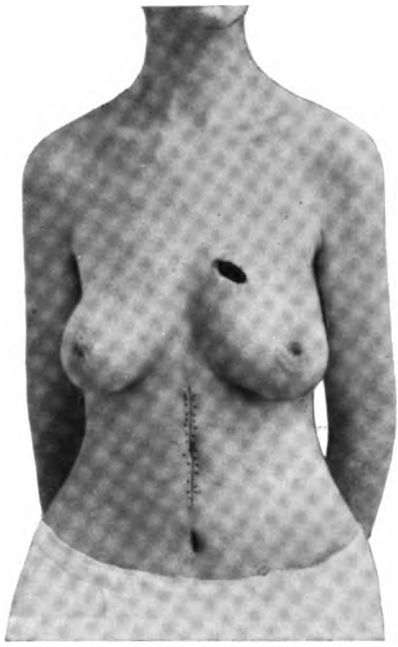

Fig. 13.—Third patient with same operation, also done under venous anesthesia and with Hültl's instrument (February, 1913). Base of tube at gastric fundus lifted up and secured to parietal peritoneum by six retention sutures; rapid recovery. Opening corresponds also to cartilage of third rib. Tube forms a distinct serpentine under skin; it might well have been put more on the stretch and would then have easily reached the second cartilage. During after-treatment an outflow of gastric contents is observed off and on, which suggests normal peristaltic motion in the tube in the direction from cardia to pylorus, very likely due to the branch of the left pneumogastric nerve which runs within the wall of the tube. Plugging the upper opening with gauze and compressing the tube against the ribs by means of a truss-like apparatus with water-pad controls the outflow satisfactorily.

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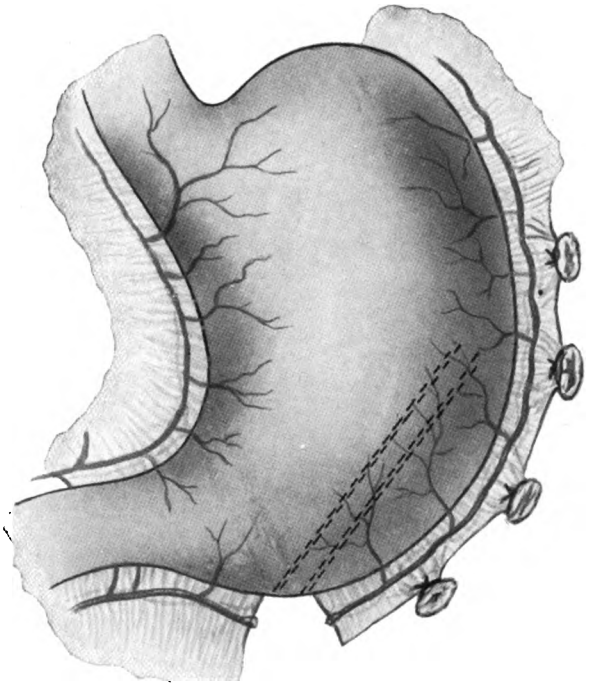

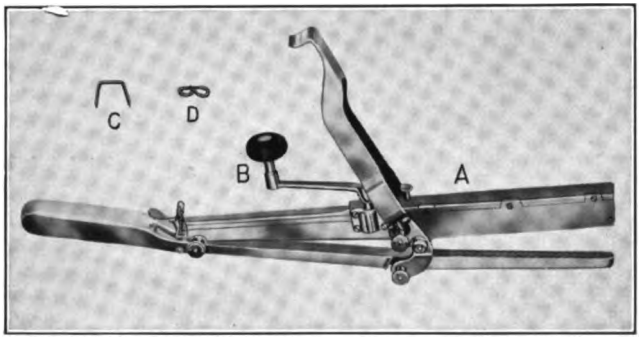

Fig. 14.—Lower illustration shows Hültl's wire-stitching instrument. *A* represents broad, square crushing clamp which harbors the four rows of staples (*C*). *B* shows crank; by turning same five times to the right after the clamp has been closed the staples are driven entirely through the tissues (wall of stomach or intestines), and either side bent inward (*D*), having met the resistance of the other branch of the clamp beneath. The bent staples are gradually pushed off in the course of healing and discharged through the rectum; they never do any harm. The upper illustration shows the double row of through-and-through wire staple sutures placed; the crushed center portion between the two inner rows is not shown.

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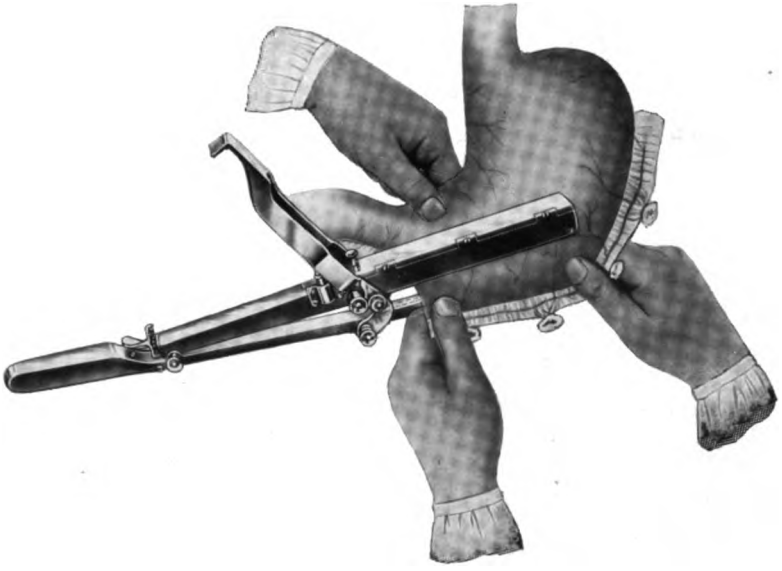

Fig. 15.—Demonstrates the placing of the instrument with the major curvature put on the stretch. The hands at lesser curvature and to the right of major are those of first assistant; the one near the pylorus at major curvature that of the second assistant.

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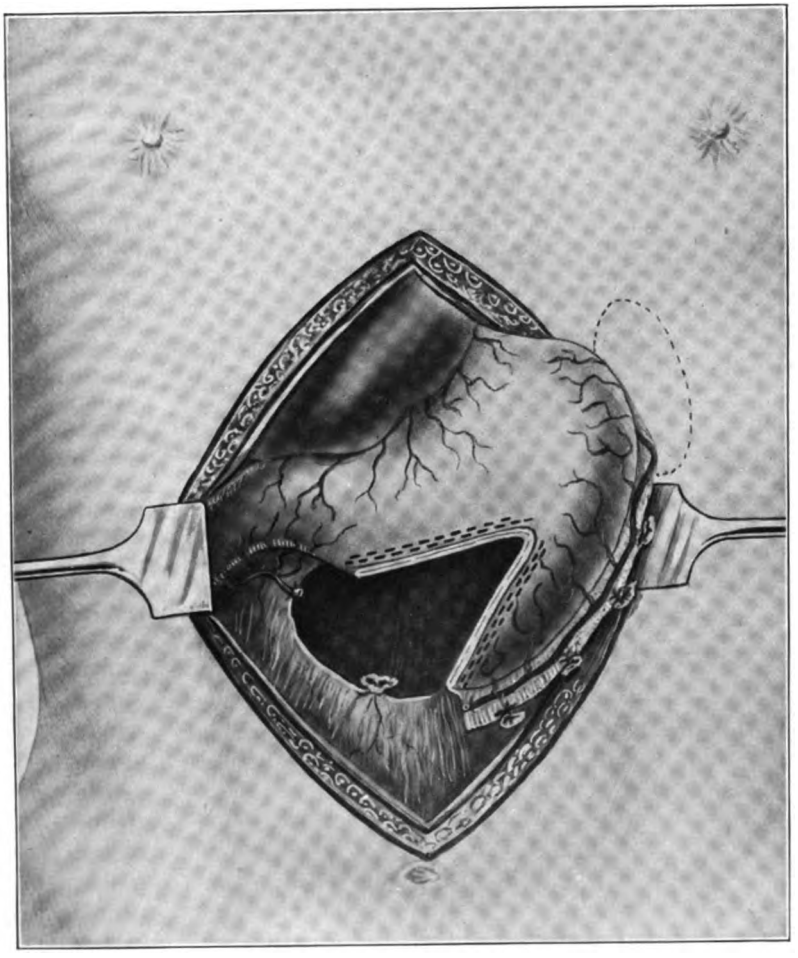

Fig. 16.—Stomach divided between the inner rows of wire staples. The operation is absolutely dry, the tip of the Jianu tube also being firmly closed by the staples.

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EXTRATHORACIC AND INTRATHORACIC ESOPHAGOPLASTY IN CONNECTION WITH RESECTION OF THE THORACIC PORTION OF THE ESOPHAGUS FOR CARCINOMA

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A year ago surgeons were still trying to demonstrate the possibility of successful resection of the esophagus for carcinoma. Gastrostomy for feeding and excision of the tumor with the working out of a safe method of inverting and closing the oral esophageal stump, which was left *in situ* within the thorax, appeared to be all they expected to achieve. The construction of a new tube for the act of swallowing—esophagoplasty—was a question that was given less consideration.

Since then the surgery of the esophagus has made such rapid strides forward that to-day the operator is obliged to include the question of the best way of forming a new esophagus when planning his operative work for the removal of a malignant esophageal stricture.

How did this rapid change come about? It seems that two factors are responsible for it:

1. The experimental designing of a new method of gastrostomy, the Jianu operation,[1] which incidentally represents the first step of inferior (or lower) esophagoplasty, and its introduction into human surgery.[2] By this operation a new tube is made by the dissecting off of a portion of the major curvature of the stomach, its

1. Jianu: Gastrostomie und Oesophagoplastik, Deutsch. Ztschr. f. Chir., 1912, cxviii, 383.
2. Roepke, W.: Centralbl. f. Chir., December, 1912.

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transposition under the skin of the thorax—extrathoracically—from below upward.

2. The performance of two resections of the esophagus for carcinoma in man, in each of which the oral stump of the esophagus is successfully transposed under the skin of the thorax from above downward, superior (or upper) esophagoplasty.[3]

In order to avoid repetition, it appears best first to review briefly the operations devised for esophagoplasty prior to the year 1912.

BRIEF REVIEW OF OPERATIONS FORMERLY DEVISED

1. Esophagoplasty[4] *by means of skin-plasty (Bircher).*[5]

Bircher showed as early as 1894 that a well-functionating, new tube for swallowing can be made from the neck down to the stomach by plastic work on the skin of the anterior aspect of the thorax.

Lexer's[6] modification of this method is as follows: Horizontal skin incision at level of cricoid cartilage and a second one parallel to it below costal arch; their outer ends united by perpendicular cut. Flap loosened, turned over and sutured to the median border inwardly to form tube of finger's size, lined with epidermis throughout; a double bridge-flap, moved inwardly from either side of the outer portion of the skin of the thorax, covers the new tube; the lower end of the latter is united with the stomach, the upper end with the neck portion of the esophagus.

2. Inferior esophagoplasty with the help of a totally excluded coil of jejunum (Wullstein,[7] *Roux*[8]*).*

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3. Ach, Alwin: Beitr. z. Oesoph.-Chir., 1913 (published as monograph by F. F. Lehmann, Munich). Torek, Franz: The First Successful Resection of the Thoracic Portion of the Esophagus for Carcinoma, THE JOURNAL A. M. A., May 17, 1913, p. 1533.

4. We must differentiate between "total" and "partial" esophagoplasty according to the length of the tube to be replaced. See P. Frangenheim, in Ergebnisse der Chirurgie und Orthopädie, 1913, v, 406.

5. Bircher, E.: Centralbl. f. Chir., 1907, No. 51.

6. Lexer, E.: München. med. Wchnschr., 1911, No. 29; Verhandl. d. deutsch. Gesellsch. f. Chir., 1911.

7. Wullstein, K. A.: Deutsch. med. Wchnschr., 1904, No. 20; Centralbl. f. Chir., 1908, No. 8.

8. Roux, C.: Semaine méd., 1902, iv.

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The operation is done in three (or four) stages. A coil of the upper jejunum is totally excluded, remaining, of course, attached to its mesentery, transposed under the skin of the thorax and then with its lower aperture connected with the stomach (Fig. 1). Herzen, Lexer and Frangenheim have proved the feasibility of the method in cases of intractable cicatricial stricture of the esophagus. Their patients recovered. Gangrene of the transposed coil easily spoils the result.

3. Inferior esophagoplasty with the help of the totally excluded transverse colon (Kelling,[9] Vulliet[10]).

The transverse colon, totally excluded, also represents useful material for the formation of a new extrathoracic subcutaneously placed esophagus (Fig. 2). As stated before, however, this kind of plastic work, ingenious as it is and important as it may prove to be, after all, for the surgery of the esophagus in the future, requires a series of operations, the first of which always has to be a gastrostomy according to one of the older well-known methods.

Jianu's gastrostomy promises to simplify this chapter of operative surgery, inasmuch as it provides for the formation of the lower portion of a new esophagus—inferior esophagoplasty—at the same time.

OPERATIONS RECENTLY DEVISED FOR ESOPHAGOPLASTY

4. Inferior esophagoplasty with the help of a dissected portion of the major curvature of the stomach (Jianu).

TECHNIC OF JIANU'S OPERATION

Jianu makes use of the major curvature of the stomach for the creation of a rather long tube, one end of which remains in connection with the gastric fundus, while the other free end can be drawn up. Before Jianu, others had tried to solve the task in a similar manner, Depage[11] by making use of the lesser curvature,

9. Kelling, G. E.: Centralbl. f. Chir., 1913.
10. Vulliet: Semaine méd., 1911, No. 45.
11. Depage: Tenth French Surg. Congr., 1903.

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and Hirsch[12] of the anterior wall of the stomach. Jianu's procedure means a decided step forward in comparison with the other two. Briefly described, it is as follows: Median abdominal incision above the umbilicus; pulling forward of stomach; double ligation and division of major omentum from a place about 2 inches from the pylorus up to the region in which the left inferior epiploic artery turns onto the stomach. Ligature of right inferior epiploic artery next to the first omental stump, formed by the ligation, completely baring the stomach wall (Fig. 3). A mattress suture is run from here through the entire thickness of the stomach about 1½ inches distant from and parallel with the greater curvature (Fig. 4, dotted line), the stomach having been lifted up by the assistant in order to have the contents run toward the lesser curvature. In placing a clamp (better still, two equally shaped clamps), corresponding to the line of the major curvature, the asepsis of this part of the operation can be materially improved and the work simplified[13] (Fig. 5). Division of the stomach with scissors right below the suture line (Fig. 4, heavy line); major curvature turned up and temporarily wrapped in a piece of sterile gauze; Connell's suture from end of mattress suture to end of stomach flap forms the latter into a tube: "Jianu's tube" (Figs. 6 and 7). A second continuous suture inverts the first along its entire length; temporary inversion of end of tube by two or three sutures, their ends being left long (Fig. 8). Stomach turned so that base of Jianu tube corresponds to upper angle of abdominal wound, where it is secured by a few stitches. Closure of lower half of abdominal wound. Jianu's tube placed on chest to the left of sternum, to measure its length; horizontal incision at level of upper end of tube, skin of thorax thoroughly undermined and new tube pulled up with long curved forceps which catches the end of the inverting sutures (Fig. 9). The latter

12. Hirsch: Centralbl. f. Chir., 1911, No. 48.
13. If the major curvature is pulled into a straight line by an assistant, a straight clamp will probably do just as well.

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removed, and mucosa—*not* the entire thickness of tube —lined to skin of transverse incision; a strip of gauze in either corner of wound for brief drainage (Fig. 10); temporary packing of the orifice of the tube with gauze; closure of upper half of abdominal incision; dressing.

A new tube of ample size, from 18 to 25 cm. long, with good blood-supply and surrounded completely by peritoneum, has thus been formed, affording splendid material for the making of a new canal through which the patient will be enabled to pass his food down to the stomach. Its base remains in connection with the gastric fundus. The placing of its free end decides the location of the new esophagus and additional operative procedures. If transposed *outside* under the skin of the thorax, the first stage of *extrathoracic* esophagoplasty has been accomplished. If pulled up into the pleural cavity, through a hole of the diaphragm as proposed by me[14] it can be used to replace the lower portion of the esophagus that had been resected for carcinoma: *intrathoracic* esophagoplasty.

So far I have carried out Jianu's operation in three patients. In the first case needle and thread were used throughout. In Cases 2 and 3 I tried Hültl's wire-stitching instrument. All three patients made a good recovery (Figs. 11-13). The new tube was in each case placed extrathoracically.[15]

OBSERVATIONS AND REMARKS

1. In view of the presence of the vasa brevia (the branches of the splenic artery) the mattress suture and incision can well be run 1½ or 2 inches further up toward the fundus of the stomach, past the onward turn of the left inferior epiploic artery, a procedure which lengthens the tube considerably. Of course, the longer the tube, the better for the patient; a difference of ½ inch may save him another operation, if the oral stump, also transposed, meets the end of the tube pulled up from below.

14. Meyer, Willy: Centralbl. f. Chir., Feb. 22, 1913, No. 8.
15. Meyer, Willy: Ann. Surg., September, 1913.

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2. The tube, when pulled up through the tunnel of the skin outside the thorax, should be put on the stretch. Its ample blood-supply will prevent gangrene. Its upper end can thus usually be brought up to the level of the third and often that of the second rib.

3. There is no sphincteric action at the base of the tube; hence it often leaks in spite of its length, if not blocked with gauze at the upper end (Fig. 12) or compressed by a truss-like apparatus. This may become a source of great annoyance to the patients and forbids this operation in case the surgeon intends the formation of a gastric fistula only. Here the old, well-tested and satisfactory methods of gastrostomy (Witzel, Kader, Ssabanejew-Frank, Senn) should be resorted to. This leakage of gastric contents may also spoil the result of additional plastic work that may become necessary. The next pressing task to be solved therefore is to improve the functional result of Jianu's tube. It is possible that twisting the tube from 60 to 90 degrees or more (according to Gersuny's method for resection of the rectum) may overcome the leakage, perhaps also a slight modification with reference to the opening communicating with the fundus of the stomach (possibly *the smaller* the better), or when suturing the upper half of the abdominal wound, for instance, lifting the stomach up by one or two sutures only, so that a kind of kink occurs at the place where the tube enters the abdomen, or by constricting the stomach at this place in some manner. A correct explanation of this leakage at the opening of Jianu's tube probably is that the normal peristaltic movements of the stomach persist in the dissected portion on account of the presence of a branch of the left pneumogastric nerve within the wall of the new tube. Further observations will have to decide this point.

4. Reduction of the size of the stomach to two-thirds of its width does not interfere any more with the gastric function, than does resection of the stomach in the

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transverse direction; the patients thoroughly enjoy their meals.

5. Subcutaneous transposition of the new tube is preferable to submuscular.

6. The patients chew their food, thus enjoying its taste; by using the physiologic action of the saliva they stimulate gastric secretion; then they deposit it in some kind of warm fluid, broth, milk or water and wash the food down into the stomach through a funnel and tube. The latter is introduced only at times of meals; it is not permanently worn. Intelligent patients need only turn the head forward and downward and blow the chewed food, with the help of a special, cup-like mouth-piece, through the Jianu tube into the stomach (Trendelenburg).

7. On basis of operations on dogs, we have made use of Hültl's wire stitching instruments to great advantage in the formation of the Jianu tube in the last two patients operated on. Hültl's instrument (Fig. 14 *a*) combines a firm compression of the tissues, to be divided, with rapid, easy and safe placing of a double row of wire staples between which division is made (Figs. 14 to 17). The operation on the stomach is therefore rendered absolutely dry and, of course, more aseptic. The time of operation is also shortened, a point which in addition to the first may be of importance in weak patients.

Including the two operations just mentioned, I have so far made use of Hültl's wire-stitching instrument in about twelve cases (resection of stomach, exclusion of the pylorus, excision of sigmoid and rectum). In every one of these cases it proved entirely satisfactory. In the formation of Jianu's tube it is simply ideal. Of course I am thoroughly aware that needle and thread are the surgeon's normal armamentarium, and have repeatedly emphasized this point before medical societies when presenting patients operated on with the assistance of Hültl's instrument. This safe placing of a double row

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of perforating wire staples within a few seconds, however, on either side of a firmly compressed central road of the wall of the stomach, or through part of the intestinal tract, then to be passed along for division by a pair of scissors (Fig. 17), is exceedingly captivating. It seems to me that Hültl's instrument well deserves a place in the armamentarium of every hospital, although its present high price may be prohibitive. It is also to be regretted that any repairs that may become necessary cannot be done on this side of the Atlantic. It is therefore to be hoped that either the price may be reduced by the manufacturers at Budapest, or that one of the many technically inclined and gifted men here may set about to construct an American instrument of this type. I have been told that in printing and bookbinding establishments a device of similar type is used for grasping the pages of the issues.

5. Inferior esophagoplasty by means of the stomach and first horizontal portion of the duodenum (von Fink).—Not infrequently a cancer of the cardia does not grow upward involving the lowest portion of the esophagus, but advances on to the cardiac portion of the stomach in the shape of a cap. Here the base of Jianu's tube would lie in an area possibly already involved in the malignant disease. In keeping away from the fundus at an adequate distance, the tube would be of no use on account of its shortness. Here one of the old methods of gastrostomy should be done, or, if extrathoracic esophagoplasty were desired, von Fink's operation would be indicated.

Von Fink[15] has shown that, after double ligature and division of the omentum majus and minus and after division of the duodenum at the junction of its upper horizontal and descending portion (Fig. 18), the entire stomach plus the first duodenal part can be transposed under the skin of the thorax through a hole made in the abdominal cavity, after resection of a portion of the left

16. Von Fink: Centralbl. f. Chir., April 12, 1913, No. 15.

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ninth rib (Fig. 19); a posterior gastro-enterostomy in the pyloric portion of the stomach closes the first stage of the operation, with a tube left in place for feeding. At the second sitting, the cancer is then to be excised, (see Fig. 20) the distal portion of the stomach closed by sutures and the proximal stump of the esophagus also transposed extrathoracically. It may sometimes be longer than needed for the completion of the esophagoplasty and has then to be shortened for end-to-end union with the transposed duodenal opening below the left clavicle. It will be extremely interesting to see whether further operations will bear out von Fink's hopes. He has carried out the transposition once with apparent success in a patient with cardiac cancer that had become adherent to and involved the liver.

6. Inferior esophagoplasty by means of the stomach and distal end of the resected esophagus.—Ach[17] proposes to make use of the stomach plus healthy distal stump of the esophagus after resection in its middle. Rehn[18] and Roepke[19] have worked in a similar direction. The procedure, if feasible, will be ideal on account of the presence of the normal cardia. The operation, however, means loosening the latter from its diaphragmatic attachment, and the necessity of providing against hernia through this hole. It also is to be seen how division of both pneumogastric nerves will affect the physiologic action of the cardia. Further, gastrostomy or inferior esophagoplasty must be done as the final step of the operation at the same sitting, a decided disadvantage.

The performance of gastrostomy after Jianu, as well as after von Fink and Ach, has no *raison d'être* in cases of cancer of the esophagus, unless the surgeon also desires to transpose the oral stump of the esophagus after resection, a procedure worked out by von Mikulicz and Kelling[20] years ago. The experience gained from two

17. Ach, Alwin: Berl. klin. Wchnschr., 1913, No. 18, p. 853.
18. Rehn, E., Centralbl. f. Chir., 1913, No. 28, Supplement, p. 50.
19. Roepke, W.: Berl. klin. Wchnschr., 1913, No. 18, p. 853.
20. Kelling, G. E.: Centralbl. f. Chir., 1904.

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patients treated with this transposition of the oral stump of the esophagus after resection has shown, as mentioned before, that it can be done successfully and without the appearance of necrosis. This fact, in conjunction with the lower half of extrathoracic esophagoplasty, accomplished with the help of Jianu's gastrostomy (or von Fink's and Ach's procedure), has rapidly pushed on the evolution of this chapter of esophageal surgery. We have learned that extrathoracic transposition of the oral stump is the simpler and safer procedure, and it has therefore to be considered the operation of choice.

We have learned that further experimental endeavors to leave the oral stump of the esophagus *in situ* within the thorax and make it either air-tight or water-tight by means of free fascia transplantation[21] would mean a waste of time and energy. It was worth while improving the latter method as long as Herzen's, Lexer's and Frangenheim's cases of esophagoplasty for intractable cicatrical strictures served as guides. These operators left the neck portion of the esophagus undisturbed, did esophagotomy above the clavicle and deviated the current of the descending food by pulling the esophageal wall strongly inward across the tendon of the sternocleido muscle, fastening it there by sutures. It could not be guaranteed that nothing whatever would enter the esophageal pouch above the stricture or artificial closure. Extrathoracic transposition of the oral stump, on the other hand, insures the decent of all the food; at the same time it greatly reduces the possibility of infection of the thoracic cavity after operation. This, in turn, renders postoperative drainage of the pleural cavity less imperative and oftener allows immediate closure of the thorax at the end of the operation with the lung fully inflated, a decided advantage for the patient.

Further observations in man will show how long the oral stump may be without risk of partial necrosis. The latter must be avoided at all hazards, as it spoils the prognosis of subsequent plastic work which may become

21. Meyer, Willy: Surg., Gynec. and Obst., 1912.

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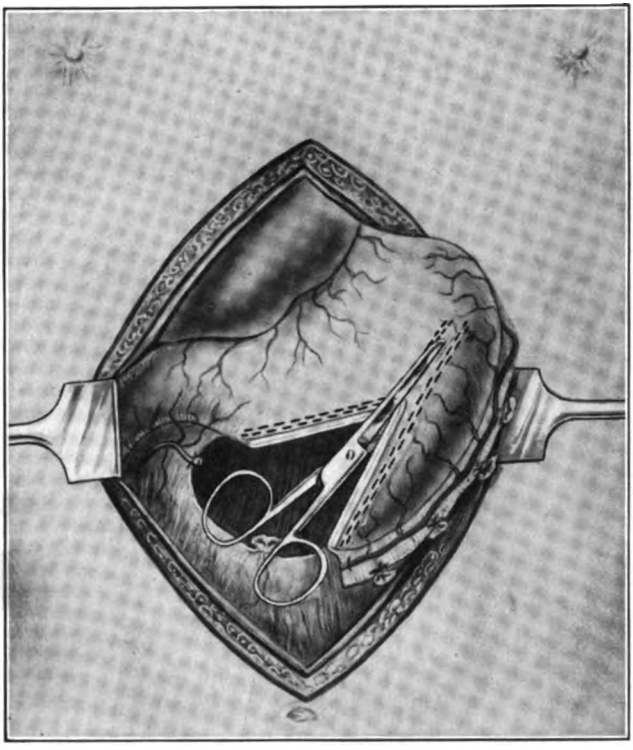

Fig. 17.—A second double row of staples is placed at an obtuse angle with Hiilti's second (smaller) instrument beyond the turn of the left inferior epiploic artery; scissors traverse the dry, crushed center portion between the inner rows.

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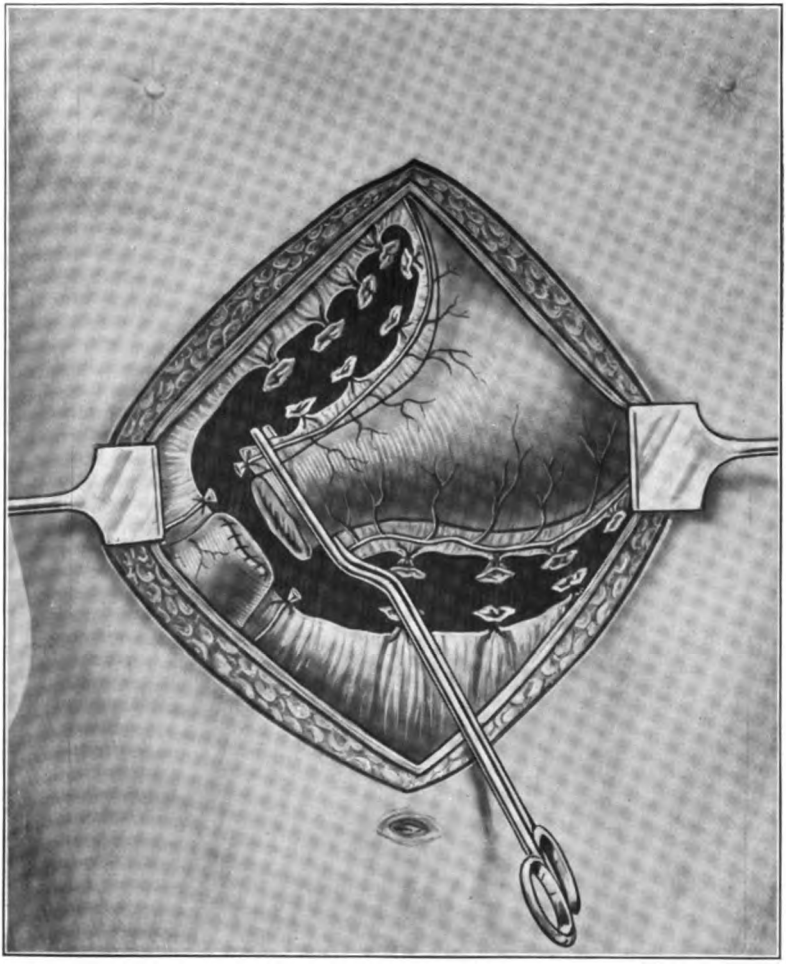

Fig. 18.—v. Fink's operation: extrathoracic esophagoplasty in the presence of cancer at the cardia or cardial portion of the stomach. The latter with first portion of the duodenum is used for the purpose. Omenta doubly ligated and divided; duodenum cut through; distal end crushed, tied and inverted; proximal end shut off by clamp, to be inverted by sutures temporarily; left superior gastric and left inferior epiploic arteries take care of sufficient blood-supply.

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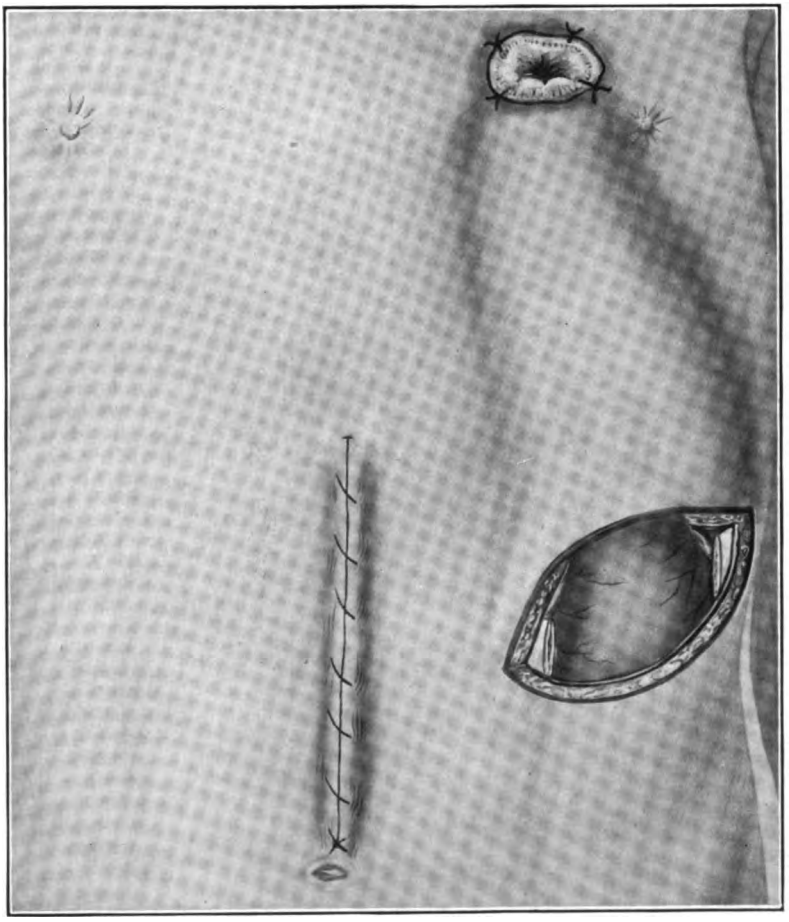

Fig. 19.—Ninth left rib resected; abdominal cavity entered and stomach with duodenum pulled through and up beneath undermined skin of thorax as far as possible; mucosa of proximal duodenal stump sutured to skin.

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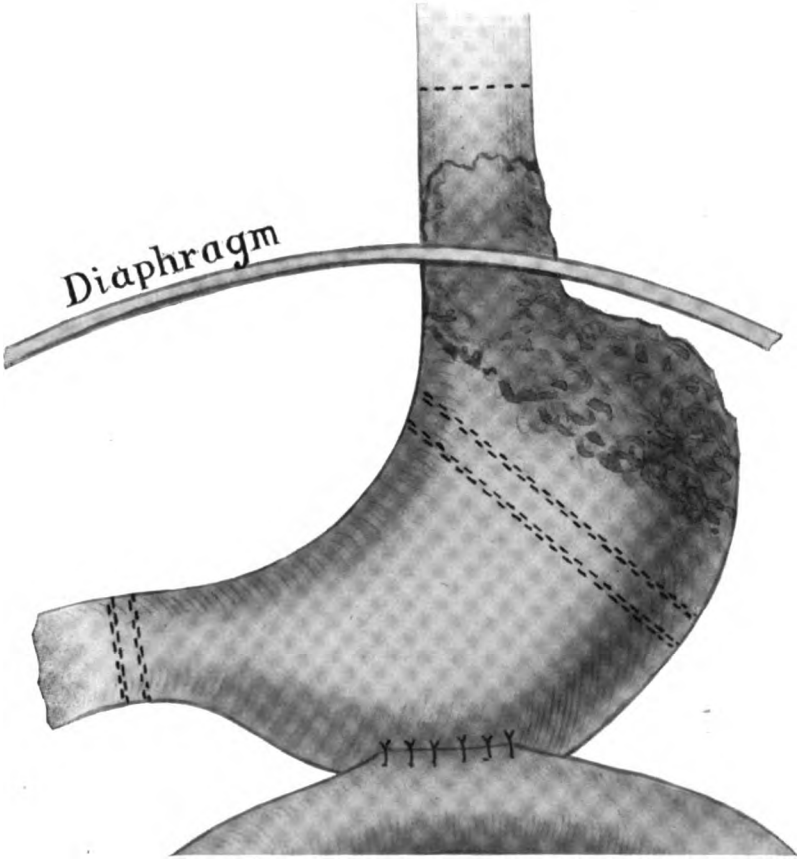

Fig. 20.—Diagrammatic sketch of cancer at the cardia involving the lower portion of esophagus. In the first stage of the operation stomach plus first part of duodenum are transposed subcutaneously upward as in Figure 19 (not shown in illustration), and a posterior gastro-enterostomy performed, with a feeding tube put in place, while making the anastomosis, from the upper open end (Fig. 19) into the efferent part of the jejunal coil. In the second stage the abdomen is opened by an ample incision parallel with the left costal arch, the latter turned up, the tumor thoroughly exposed and loosened, the posterior mediastinum entered, tumor cut out, stomach end inverted, esophagus crushed above tumor and temporarily tied, loosened by hand as far up as possible and then extracted through the neck wound above clavicle. It is then also placed extrathoracically under the skin, shortened as much as required and united by end-to-end suture with the open, freshened proximal stump of the duodenum. In spite of a rather complicated pathologic condition, the tumor is thus not only thoroughly excised, but a new esophagus made and the possibility of normal downward descent of food for physiologic digestion and assimilation reestablished.

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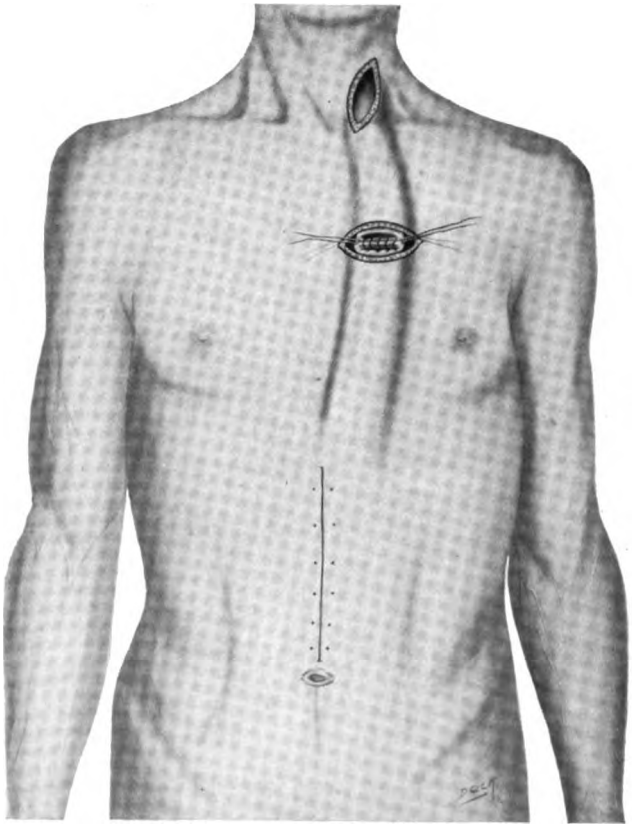

Fig. 21.—Last step of the two-stage operation just described.

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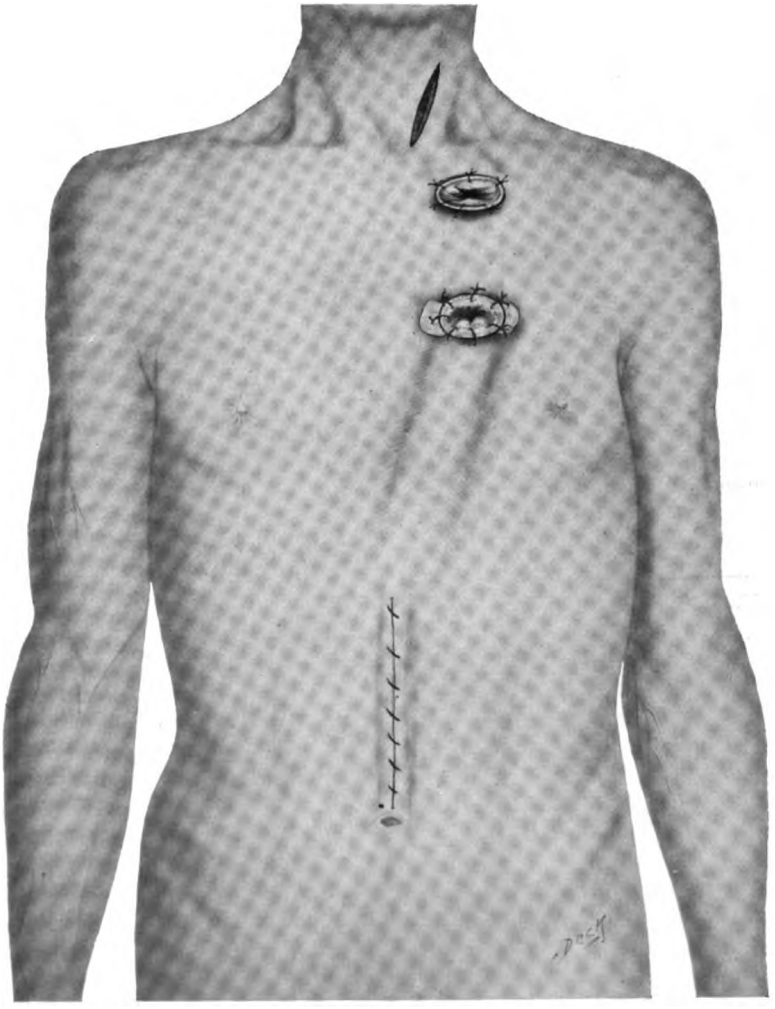

Fig. 22.—Illustrates the condition, if the proximal esophageal stump be too short, as to meet the opening of the tube pulled up from below. Here the two openings may be united by a rubber tube with a blown-up bulb at its upper extremity, the tube having been drawn downward through the mouth (Gluck-Perthes method). If the patient is dissatisfied with such an arrangement a modified skin-plasty according to Bircher is indicated. To insure success of such plastic work regurgitation of food and stomach juices must be reduced to a minimum.

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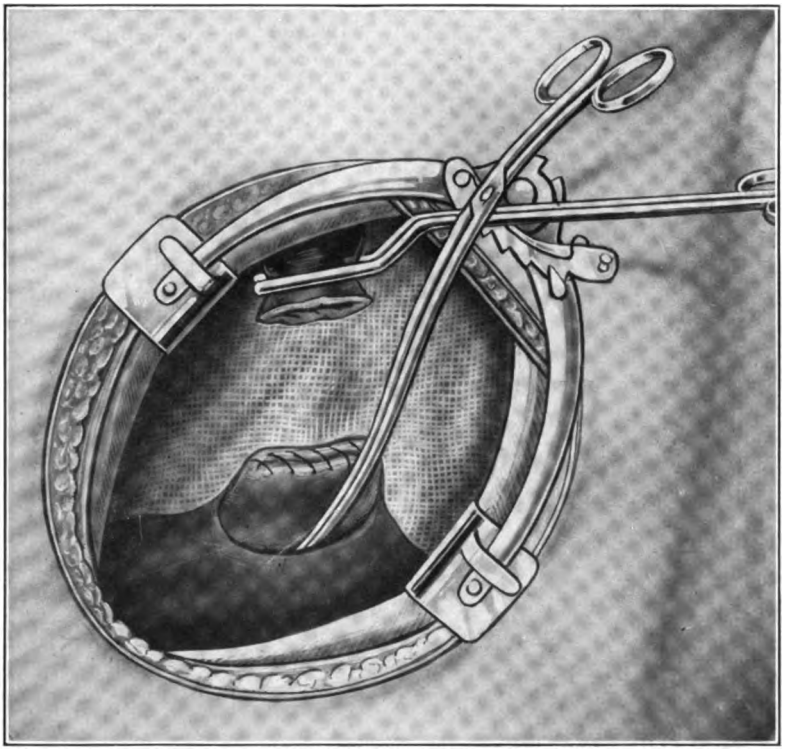

Fig. 23.—Intrathoracic esophagoplasty. After the Jianu tube has been formed through abdominal incision, as shown in Figure 3-17, patient is turned on right side and thorax opened by an incision in seventh intercostal space; rib-spreader in place; esophagus isolated and tumor excised; clamp occludes proximal end; distal end inverted. Abdominal cavity bluntly entered alongside closed cardia and the temporarily occluded Jianu tube pulled with a long curved dressing forceps into thorax where it is to replace the excised lower third of esophagus. Care must be taken not to twist the Jianu tube in the course of this transposition, for which the abdominal wound, which was temporarily clamped, may be reentered by the surgeon's left hand in order to assist manipulation. Or the abdominal wound can be thoroughly closed by sutures after the long threads at inverted tip of the Jianu tube—wrapped in a piece of moist gauze—have been placed right beneath foramen esophageum of the diaphragm. Practical experience in man must decide which method is preferable.

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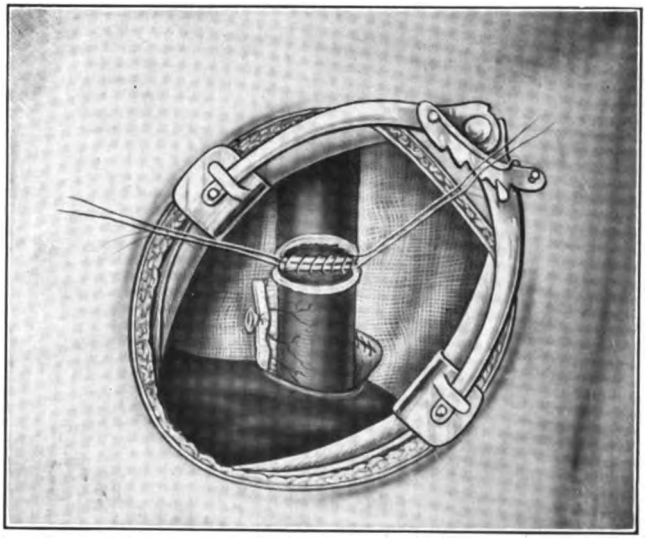

Fig. 24.—Inverted tip of Jianu tube released and cut off; redundant gastric mucosa clipped and both openings in process of end-to-end union by suture. There is splendid blood-supply up to the tip of the Jianu tube from the left inferior epiploic artery within the ligated major omentum, which latter always is to point toward the patient's right.

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necessary, or even renders it impossible altogether. If it is of sufficient length to meet the opening of Jianu's tube, end-to-end suture, as mentioned, will finish the extrathoracic esophagoplasty in the happiest way (Fig. 21). If too short, a subsequent skin-plasty after Bircher[5] must bridge the defect (Fig. 22). Or, if further operating was not desired, or was contra-indicated, then a rubber tube, connecting both openings (Gluck,[22] Perthes) will establish the continuity of the tube and therewith enable the patient to swallow his food, a consummation most ardently desired by all.

It is in view of this invariable desire on the part of these patients in whom gastrostomy was performed that I have decided not simply to close the thorax in cases in which exploratory thoracotomy has shown the disease inextirpable, but to divide the esophagus in proper distance from the upper pole of the tumor and then transpose the oral stump extrathoracically, after closure of the distal part by inversion and suture (one personal observation so far).

PALLIATIVE OPERATION IN INOPERABLE MALIGNANT STRICTURE OF THE ESOPHAGUS FOR THE SAKE OF REESTABLISHING THE ABILITY TO SWALLOW

This palliative treatment repeats in cancer of the esophagus what we are wont to do by means of gastroenterostomy in cases of inoperable and obstructing pyloric carcinoma. As an operation it corresponds to Madelung's procedure in inoperable cancer of the rectum and sigmoid. There is usually still sufficient drainage through a narrow and tortuous canal in the center of the tumor downward into the stomach. The patient will gain in weight after recovery from the operation; he will, for a time at least, again be able to swallow and will consider himself cured. Later on his hopes can be kept up as long as possible by the surgeon's promises, a

22. Gluck, Th.: Berl. klin. Wchnschr., 1898, No. 42.

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humane procedure. So far, I have had one chance to carry out this operation; it could be nicely accomplished.

From my experience gained in six cases of esophageal resection for advanced carcinoma I should advise to leave alone an infiltrating carcinoma behind the aortic arch which covers several inches of the tube, when performing thoracotomy on patients who show symptoms of *complete obstruction for some time* prior to operation. Attempts at removal will greatly weaken the resisting power of these reduced patients and eventually force the surgeon to continue radical work much against his wishes. On the other hand, palliative work — division of the esophagus above the stricture, closure of the distal end and extrathoracic transposition of the oral stump, as described before — do not tax the patient to any extent and will brighten the rest of his life.

It should be stated here emphatically that a preliminary gastrostomy is of greatest importance in resection of the esophagus for carcinoma. It may become necessary, when operating on the lower third of the esophagus, that both pneumogastric nerves have to be divided, a procedure that is thoroughly defendable. But if then gastrostomy is added, necessarily at the same sitting, the fistula cannot be made water-tight; Ach as well as I have seen that it will leak after this division of the nerves, and eventually may prove to be the cause of death.

Frangenheim demands a primary gastrostomy for every kind of esophagoplasty, including that of Jianu, and there surely is also with this method a sufficient amount of stomach wall left to make a gastric fistula according to Kader or Senn near to the pylorus. It is to be hoped, however, that the future will show that the necessity of entering the stomach in two places, namely, making two gastric fistulas, will not be a matter of necessity when using Jianu's operation. For, if the transposed proximal stump is of sufficient length, end-to-end union by suture will finish the plastic work; if too short, the temporary placing of a soft stomach-tube

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for feeding purposes when finishing the work by means of skin-plasty may be all that is needed. We must always bear in mind that Jianu's operation represents inferior esophagoplasty and a gastrostomy.

It is, as a matter of course, impossible at the present moment to say which method of extrathoracic esophagoplasty will prove to be the preferable one. If the task of preventing regurgitation of stomach contents through the Jianu tube can be solved, then this method of gastrostomy and inferior esophagoplasty will be the operation of choice, principally on account of its simplicity and comparative absence of danger. If it will be shown, however, that this cannot be done and that the digestive effect of returning stomach juice will spoil plastic work that may become necessary later on, then the Wullstein-Roux method, or very likely Kelling-Vulliet's transposition of the excluded transverse colon will best be resorted to. At the present juncture it should be emphasized again that efforts of surgeons should be directed toward improving the functional working of Jianu's tube.

EXPERIMENTAL INTRATHORACIC ESOPHAGOPLASTY

In cases in which examination previous to operation has shown the cancer to be located within the lower third of the esophagus, or localized right at the cardia itself (scirrhus) and immediate esophagogastrostomy does not appear feasible on account of the distance of the proximal end, the excellent plastic and well-nourished material of Jianu's tube makes one wonder whether or not the excised lower portion of the esophagus or cardia might be immediately replaced by this tube if brought up intrathoracically into the pleural cavity through the foramen esophageum of the diaphragm or alongside the cardia which had been closed by sutures after the resection (Fig. 23), its free opening to be united by end-to-end anastomosis with the oral stump of the esophagus which otherwise remains *in situ* undisturbed (Fig. 24).

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A patient thus operated on, in the early stage of the disease, would live on after the operation the same as he did before he became afflicted with the cancer. Of course, there might be some annoying rumination in view of the missing sphincter at the base of the Jianu tube, same as in the extrathoracic placing of the latter; but in the course of further experience with the method, we might find a way to overcome such regurgitation as before mentioned. The operation has not proved a difficult one in our animal experimentations. The only drawback of this seemingly ideal procedure is that so far as we know at present, the entire work has to be done in one sitting, whereas in extrathoracic esophagoplasty, Jianu's operation can be done in the first stage and resection of the esophagus with transposition of the oral esophageal stump in a second. A patient afflicted with malignant disease will hardly have sufficient power of resistance to stand the operation in one sitting. Ways will have to be worked out experimentally to make intrathoracic esophagoplasty also a two-stage operation. It is our intention—Dr. Martin Rehling continues to assist me in thoracic work we are doing at the hospital and experimentally—to devote a part of the coming season to this question. It would seem practicable to divide as follows:

First Stage.—Formation of Jianu's tube; temporary inversion of its tip; thoracotomy; introduction alongside cardia or by special hole through diaphragm into pleural cavity where the tip is fastened with a few stitches to the costal pleura, keeping the tube well stretched; closure of the diaphragmatic incision.

Second Stage (as soon as possible after first).—Second thoracotomy; resection of tumor; end-to-end union by suture.

For the latter we prefer a double layer, first, an inverting Connell through-and-through, after the projecting cuff of mucosa of the Jianu tube has been clipped; second, a continuous suture on top; a non-compressing cuff of free fascia graft may be advantage-

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ously placed on the line of anastomosis. Postoperative drainage under differential pressure seems preferable to closure of the thorax without drainage, because the lumina of both tubes, though they were disinfected, have been open for quite a while.

So far, I have done the operation six times with the intention of saving the dog, closing the thorax completely, but cannot report a recovery. Acute gangrene, due to compression by the diaphragm; secondary hemorrhage from a pierced artery of the latter when suturing its rent to the Jianu tube; a leak in the suture line; collapse of the lungs owing very likely to compression by air on account of the communication between thoracic and abdominal cavity, and shock, have been the principal causes of death.

When the operation is done in man, death might be guarded against—following the order of renumeration—by making the incision alongside the cardia of ample size, dividing principally the ligamentous part of the foramen esophageum toward the spinal column, before pulling the tube into the thorax; placing the few diaphragmatic sutures under the guidance of the eyes, having caught the diaphragmatic abdominal peritoneum with forceps, properly everting the peritoneum; addition of a fascia graft; drainage plus differential pressure after-treatment; two-stage operation.

CONCLUSION

As stated before, intrathoracic esophagoplasty, when properly worked out, would seem to be an ideal operation. If further observations in man, however, should prove that the transposed oral stump of the esophagus, no matter how long, has no tendency to become necrosed in its distal portion, but will live as a rule, further experimental work for the perfection of intrathoracic esophagoplasty will be less urgent and extrathoracic esophagoplasty will become the operation of choice for resection of carcinoma in any part of the esophagus.

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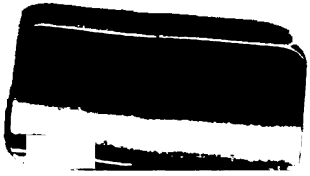

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